

Blood Supply of the Brain

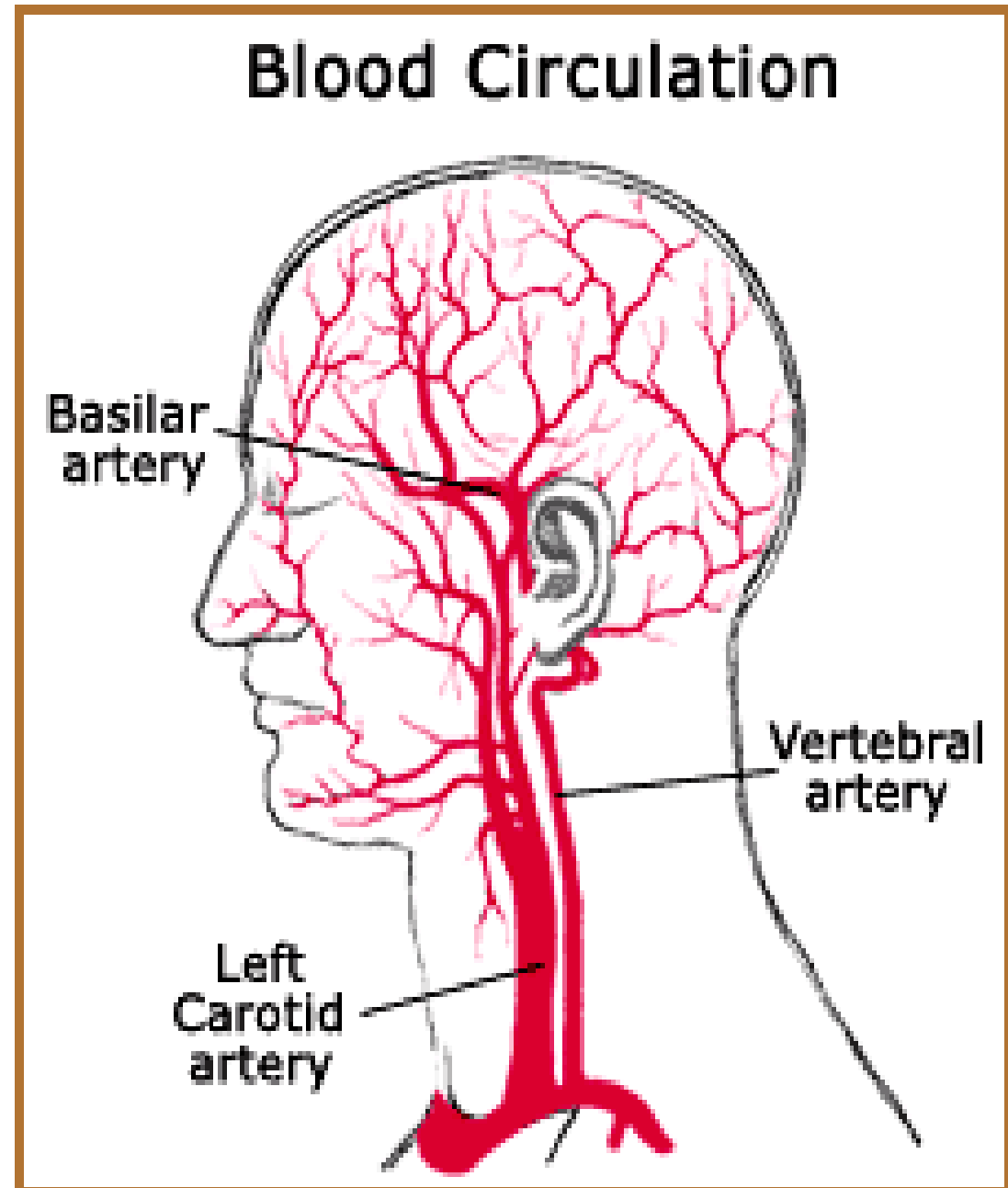
By
Dr. Noura El Tahawy

OBJECTIVES

- Illustrate and describe the formation of the circle of willis
 - Describe the blood supply of the brain
 - Arterial supply
 - Venous drainage
-

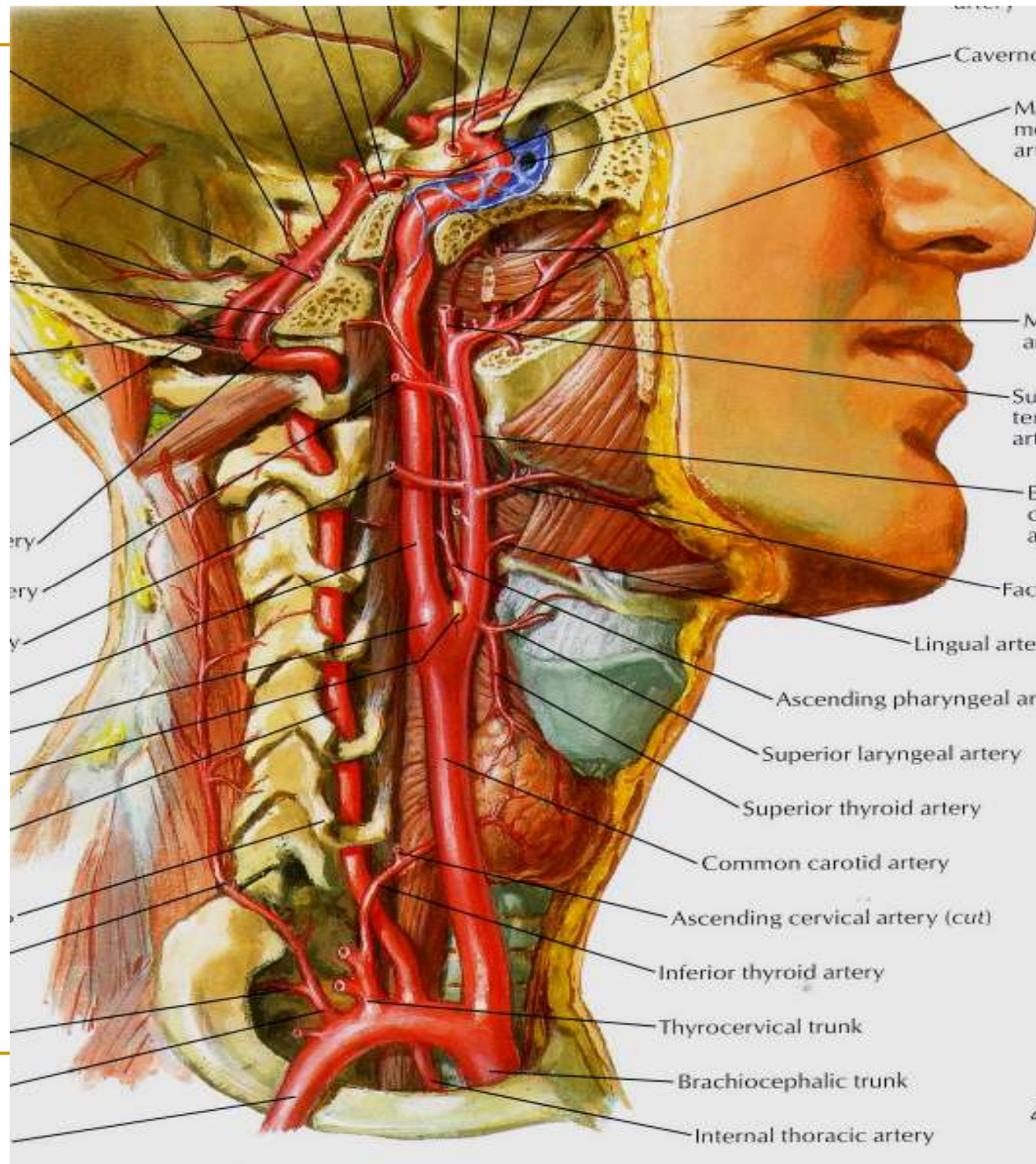
Blood Supply of The Brain

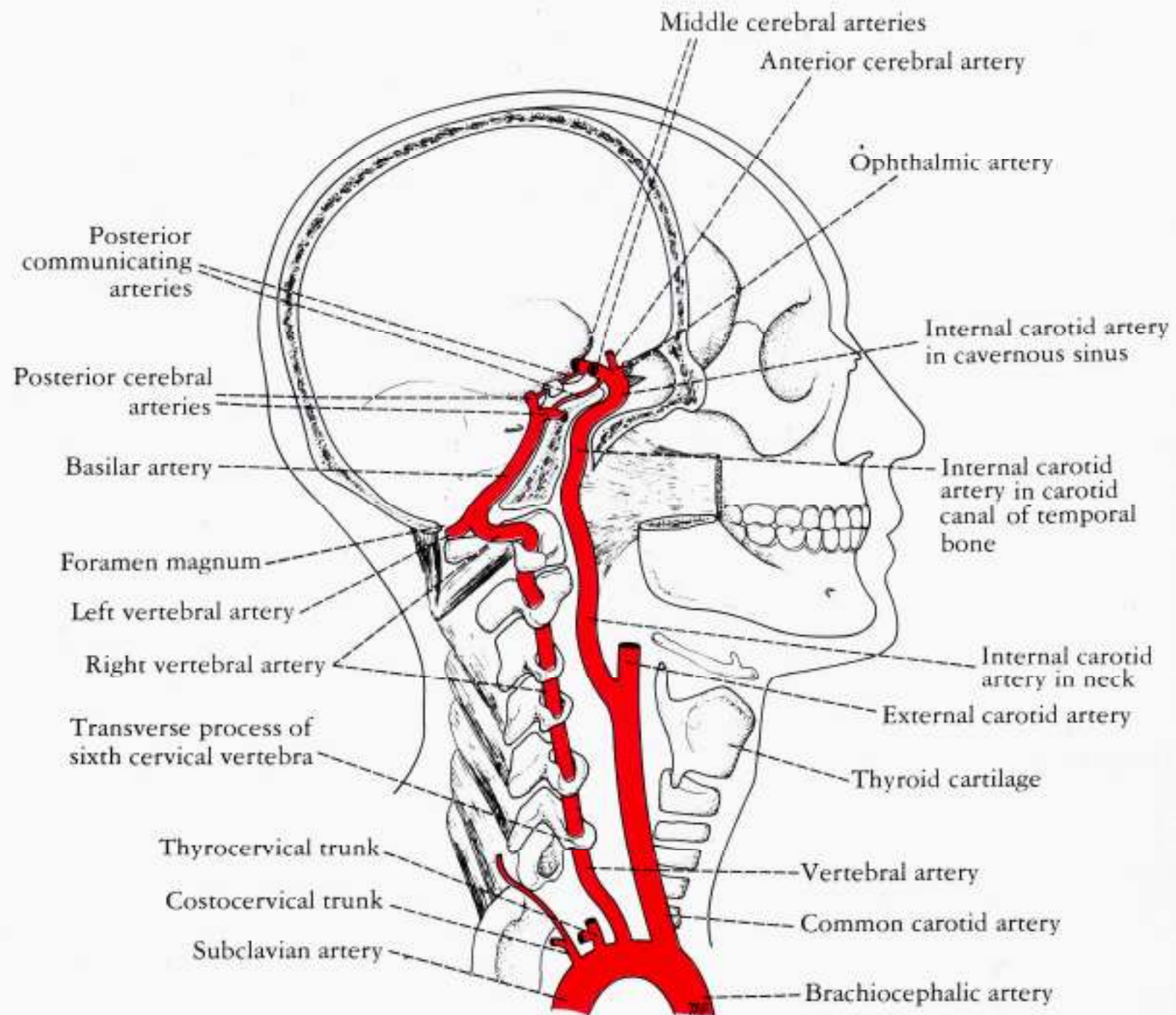
- The brain receives its arterial supply from two pairs of vessels, the *vertebral* and *internal carotid arteries* which are interconnected in the cranial cavity to produce an *arterial circle (of Willis)*.

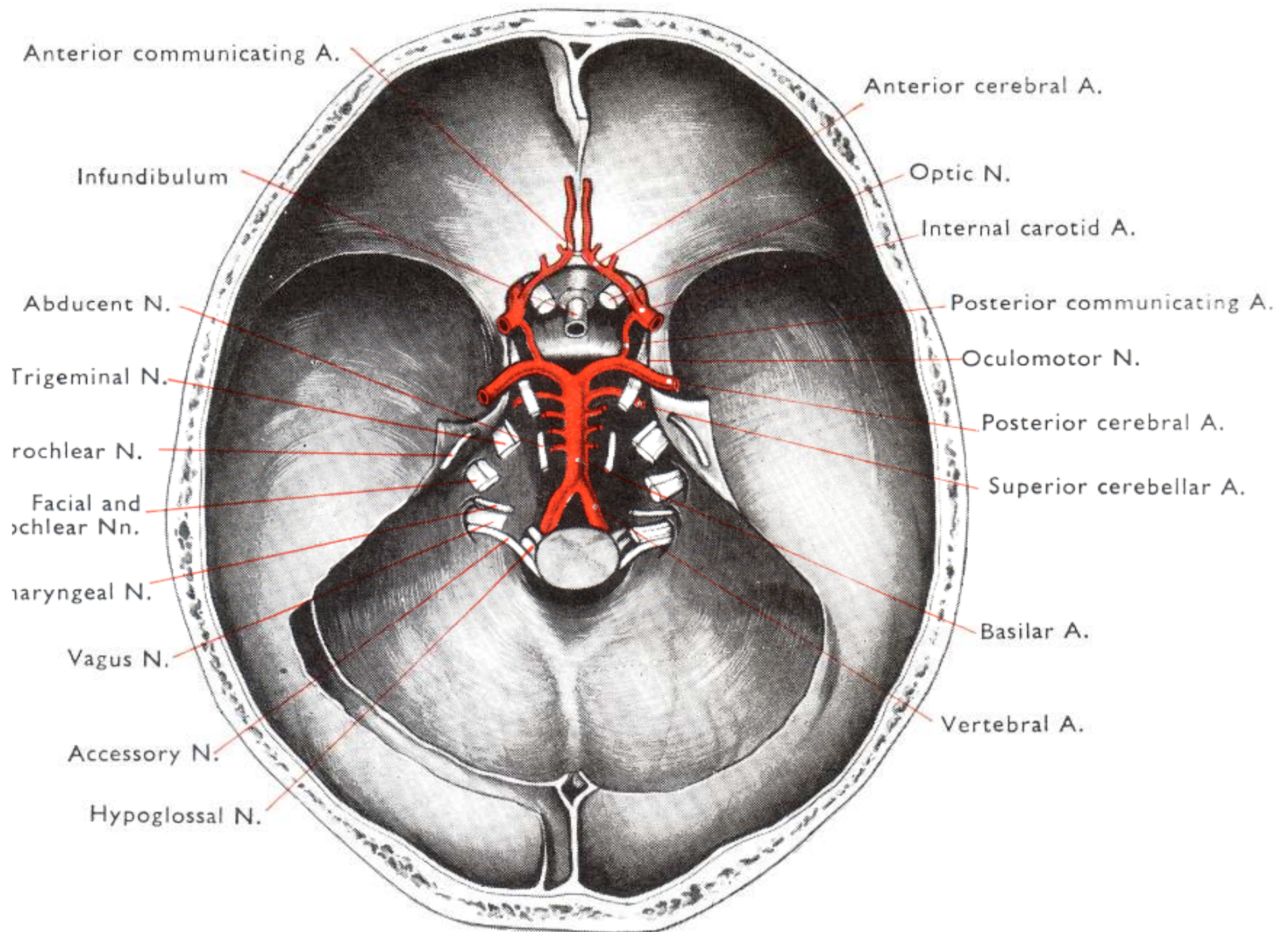


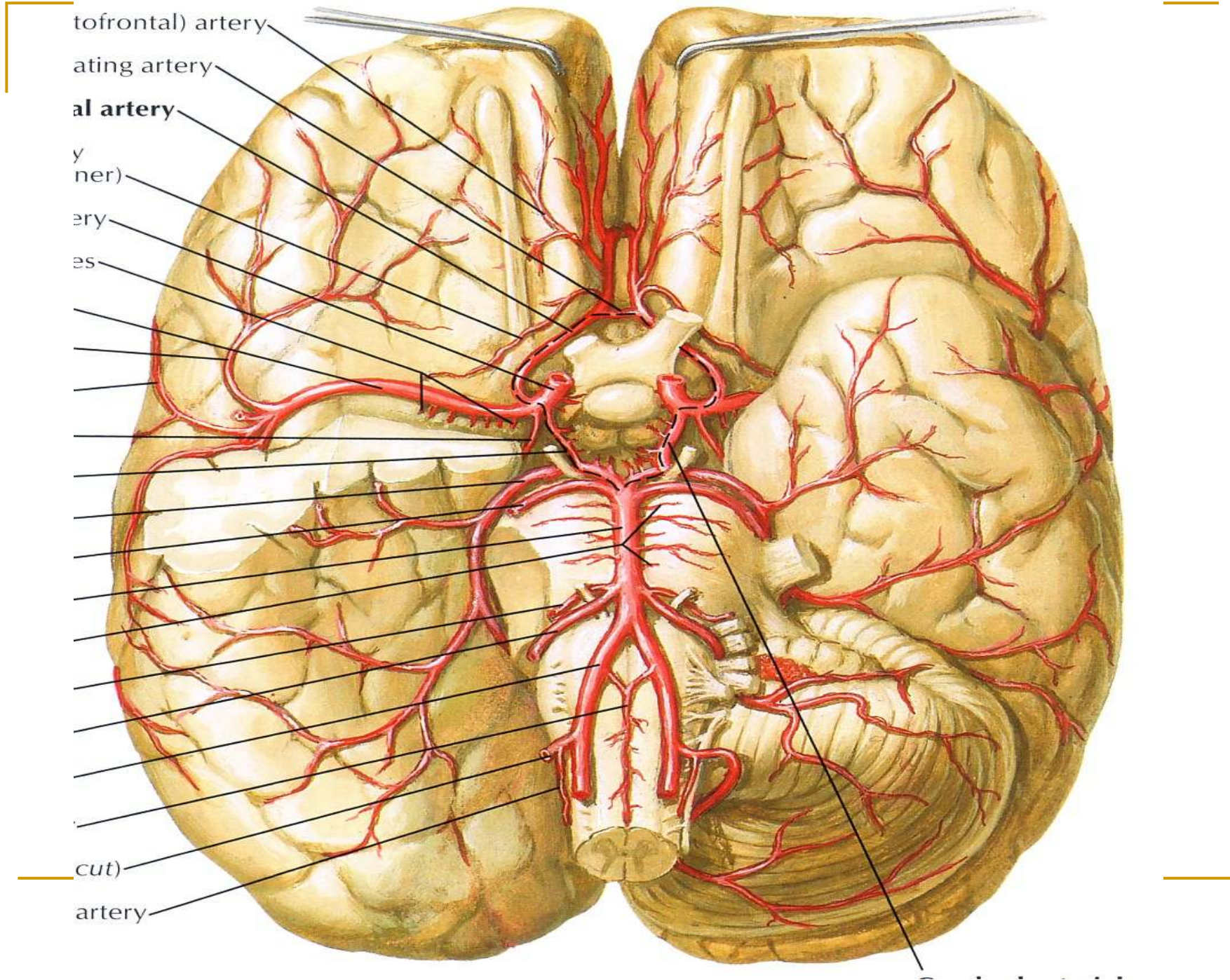
I. Vertebro-Basilar system

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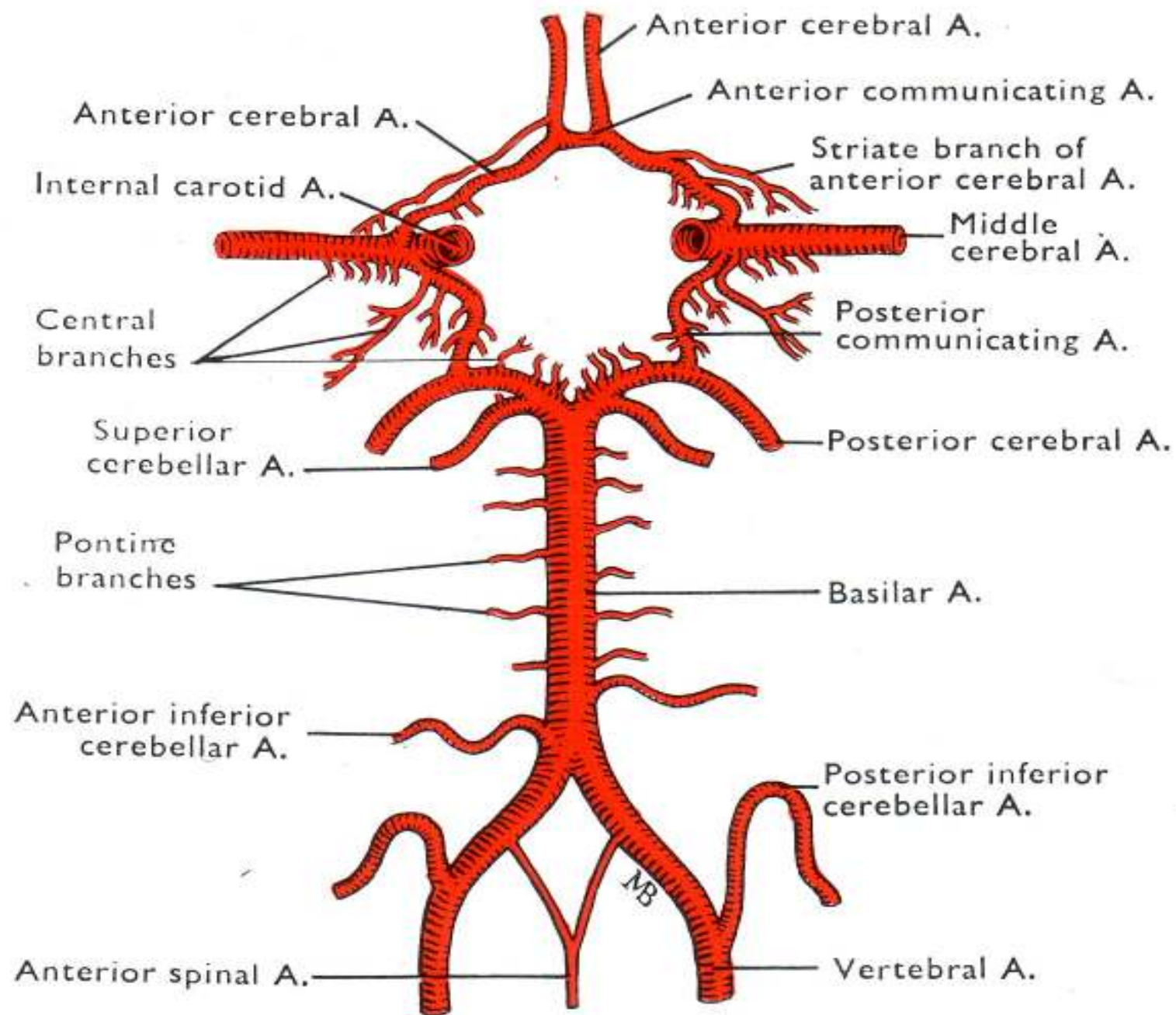


Vertebral artery

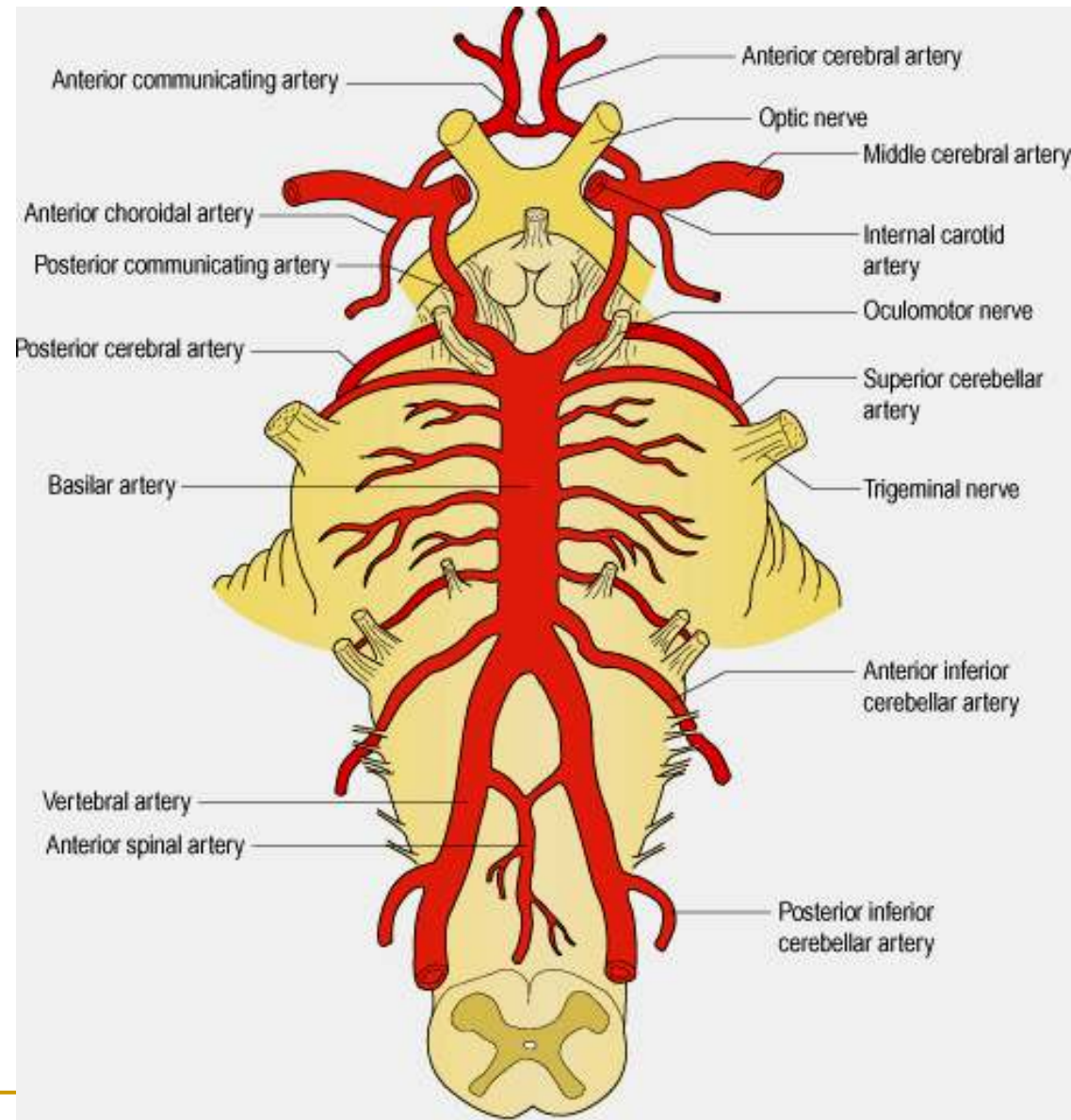
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Vertebral Artery

- Branch of first part of subclavian A
 - Passes – foramen transvesarium C6 – C1
 - Enters through foramen magnum – perforates dura & arachnoid mater – enters subarachnoid space
 - Turns upward, forward, medially – medulla oblongata
 - Lower border of pons – joins opposite side to form
 - ***BASILAR*** artery
-

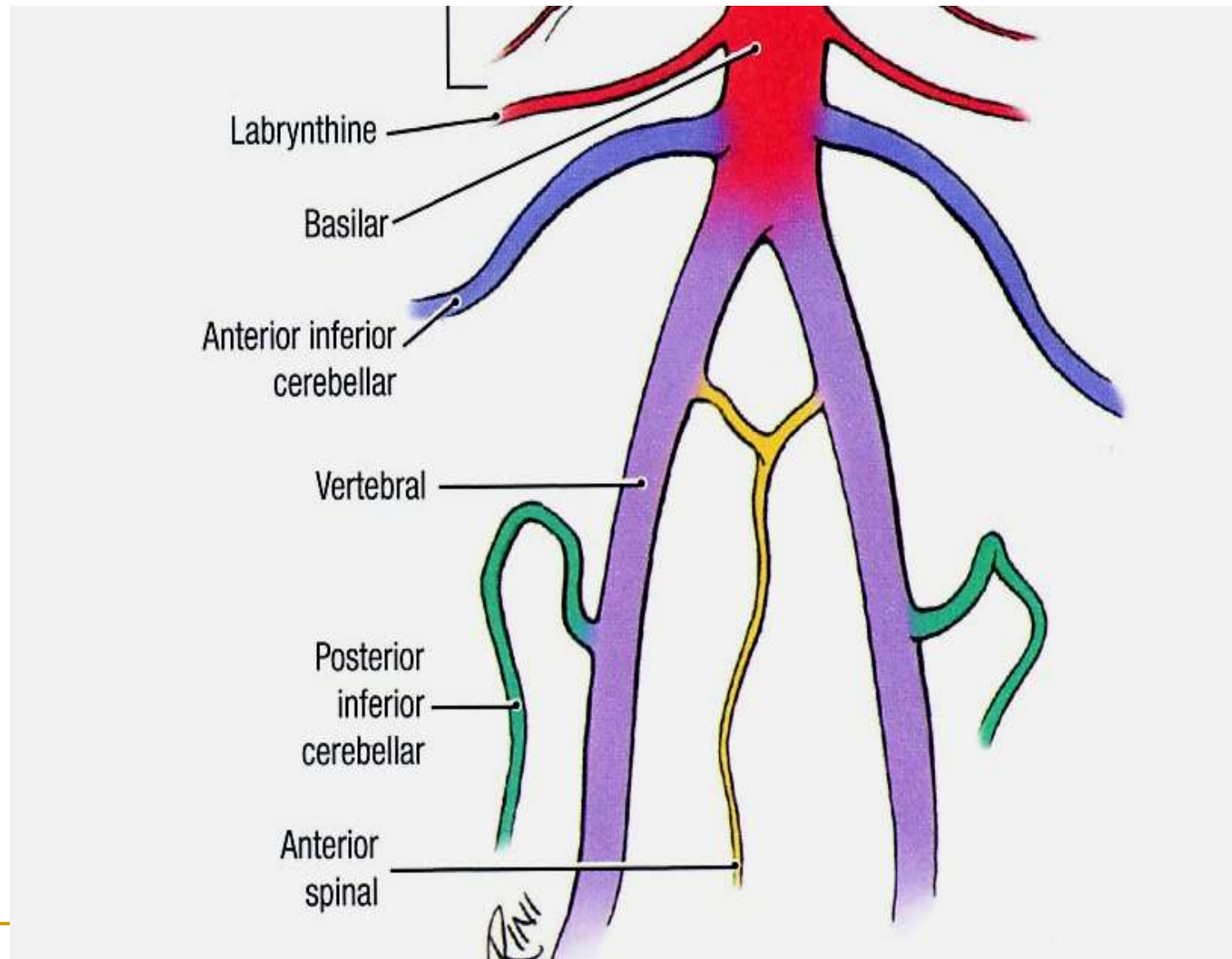


Schematic drawing of the arrangement of arterial vessels on the base of the brain.

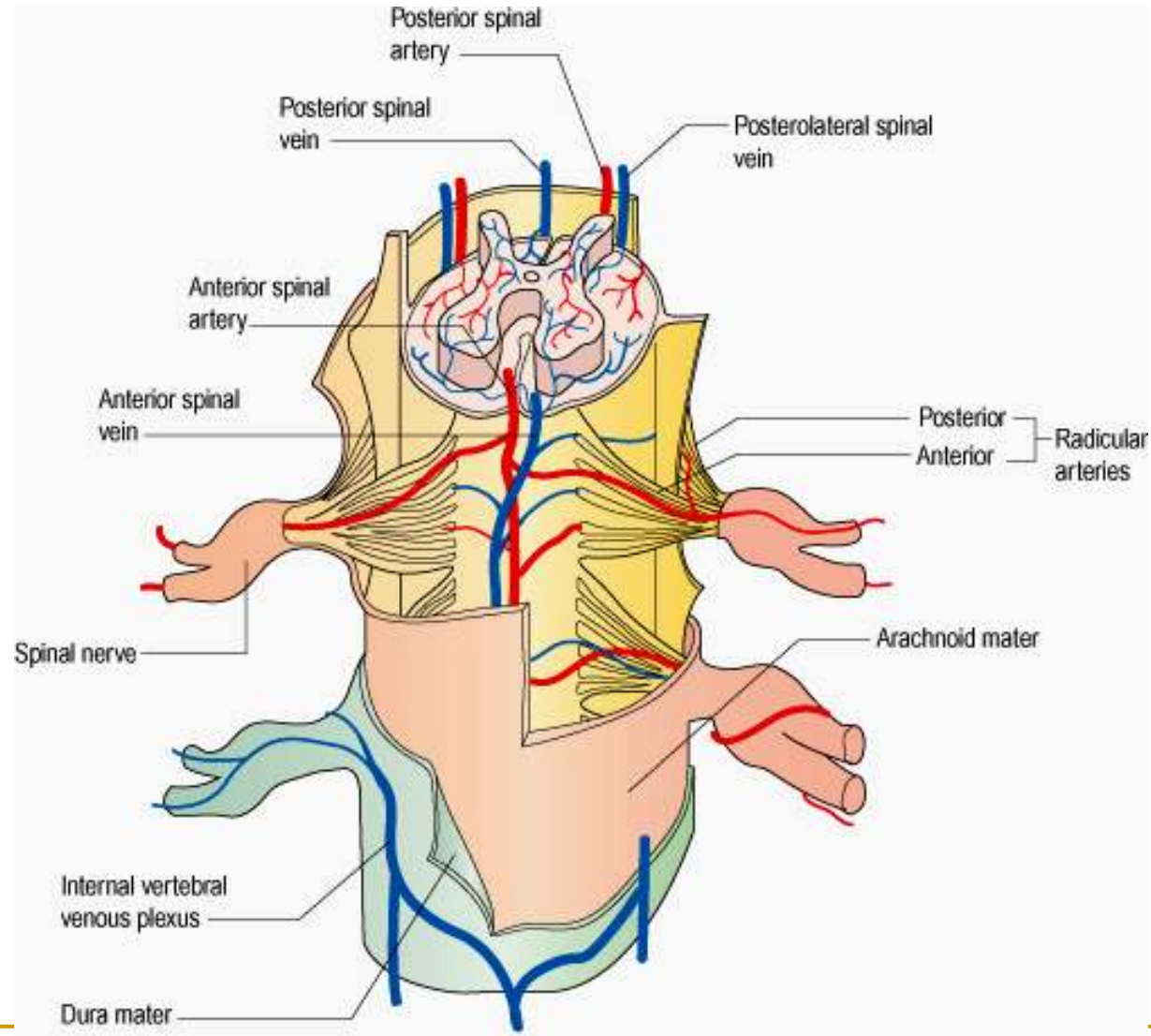


The diagram shows the circulus arteriosus (circle of Willis).

Branches of vertebral artery



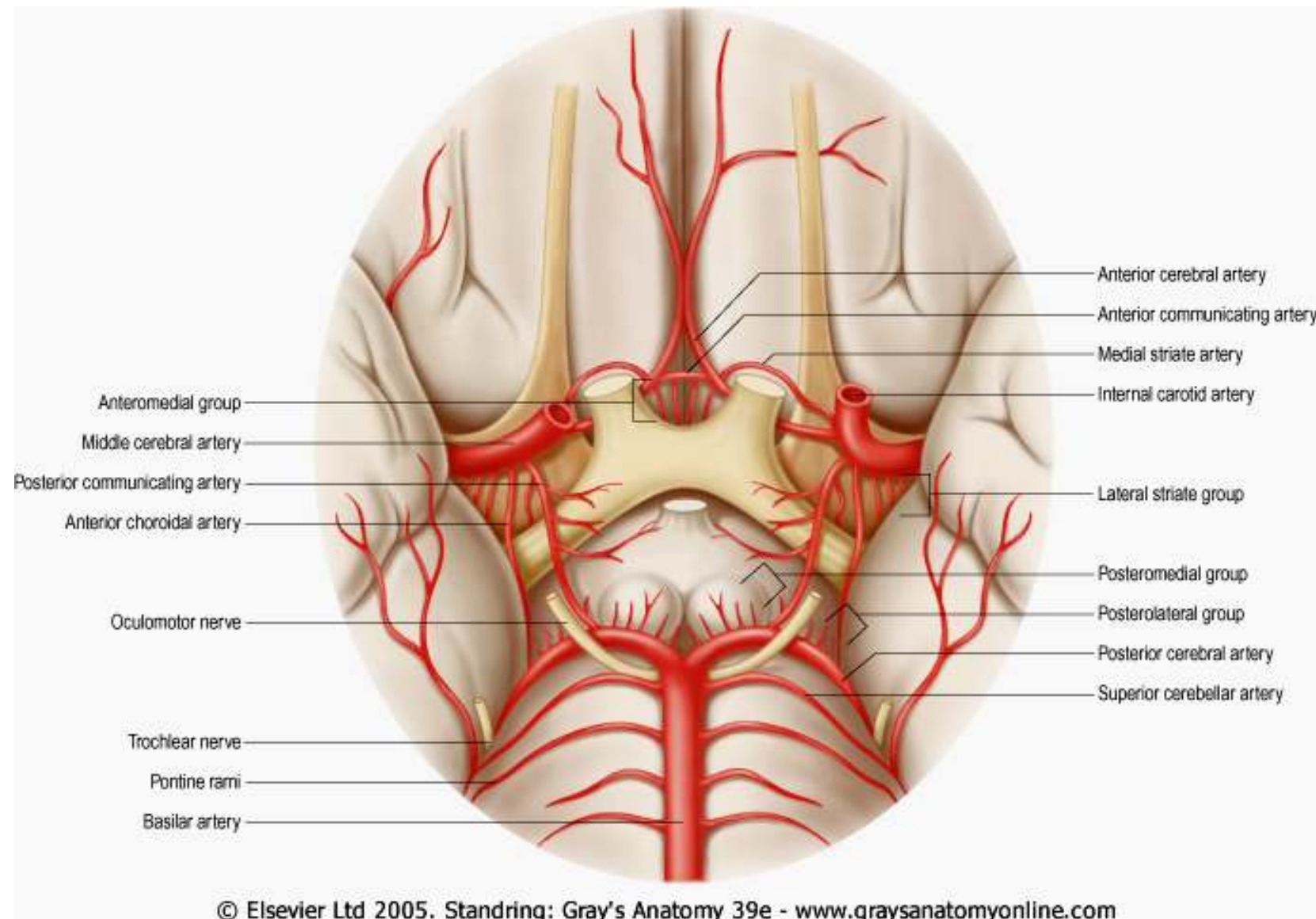
the arterial supply (red) and venous drainage (blue) of the spinal cord.



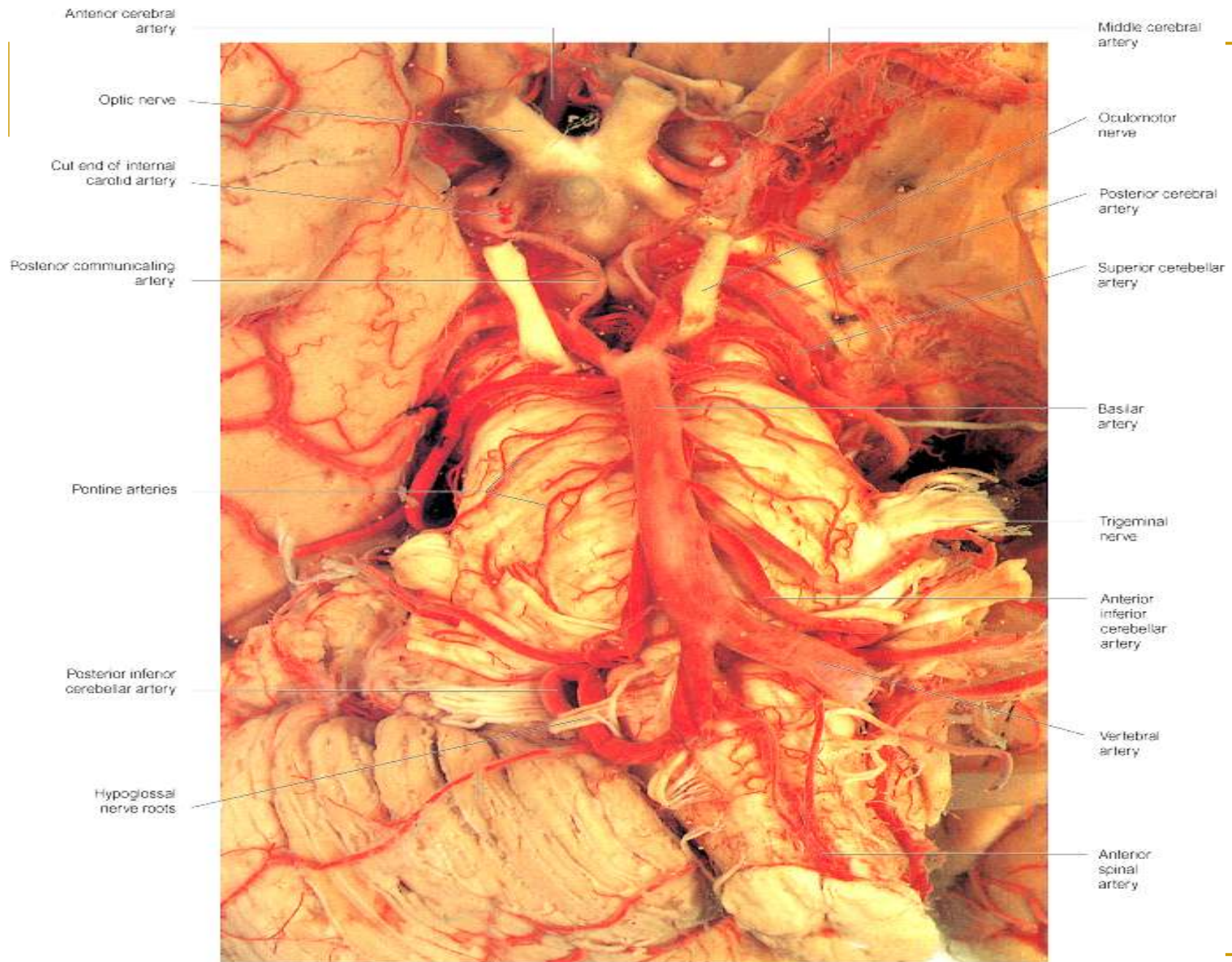
Basilar Artery

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-
- Formed by the **union** of the two vertebral arteries at the **lower border** of the **pons**
 - Ascends on the front of the pons lodged in the **basilar groove**
 - Ends at the **upper border** of the pons by dividing into 2 **Posterior cerebral arteries (PCA)**
-

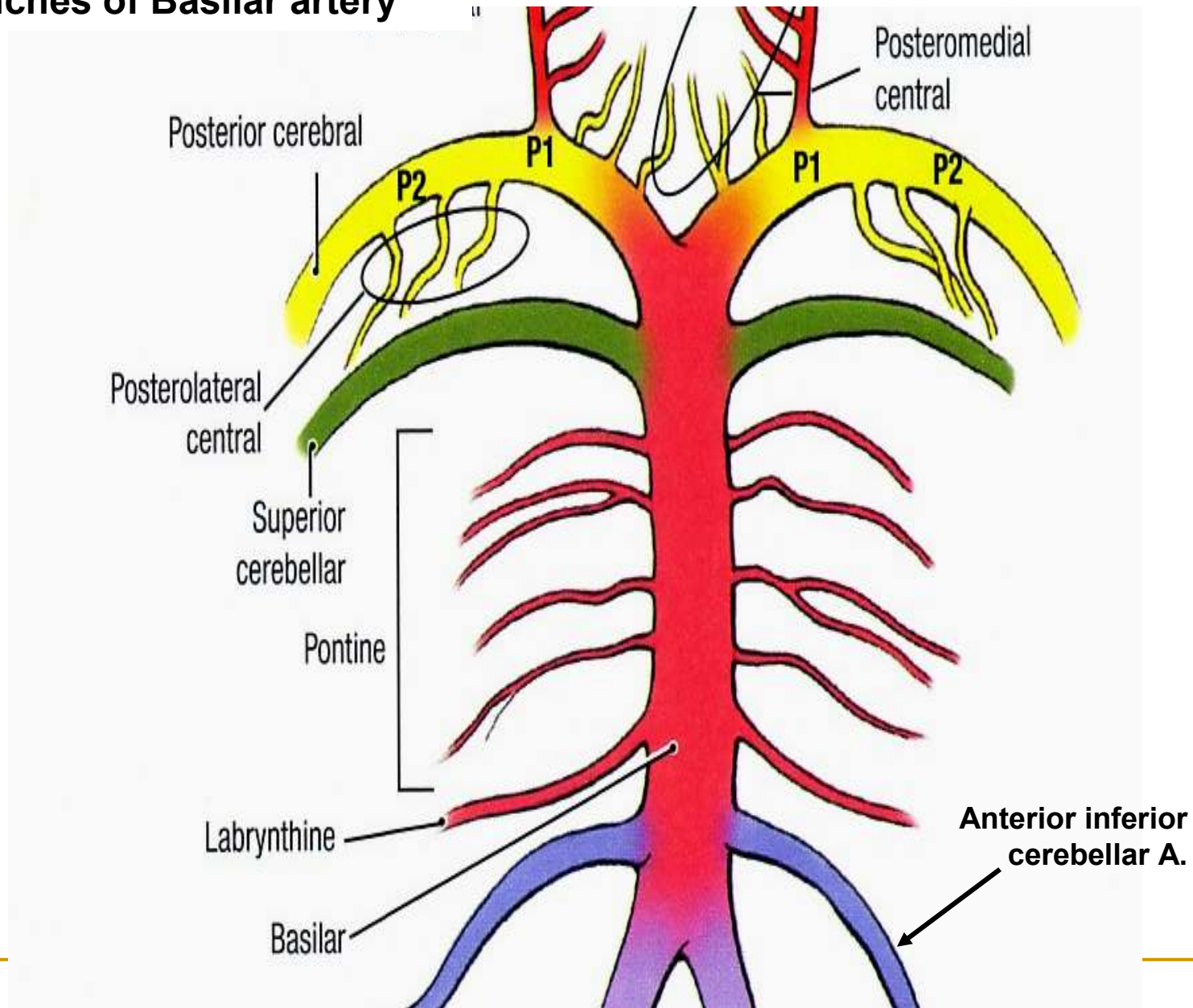


The circulus arteriosus on the base of the brain

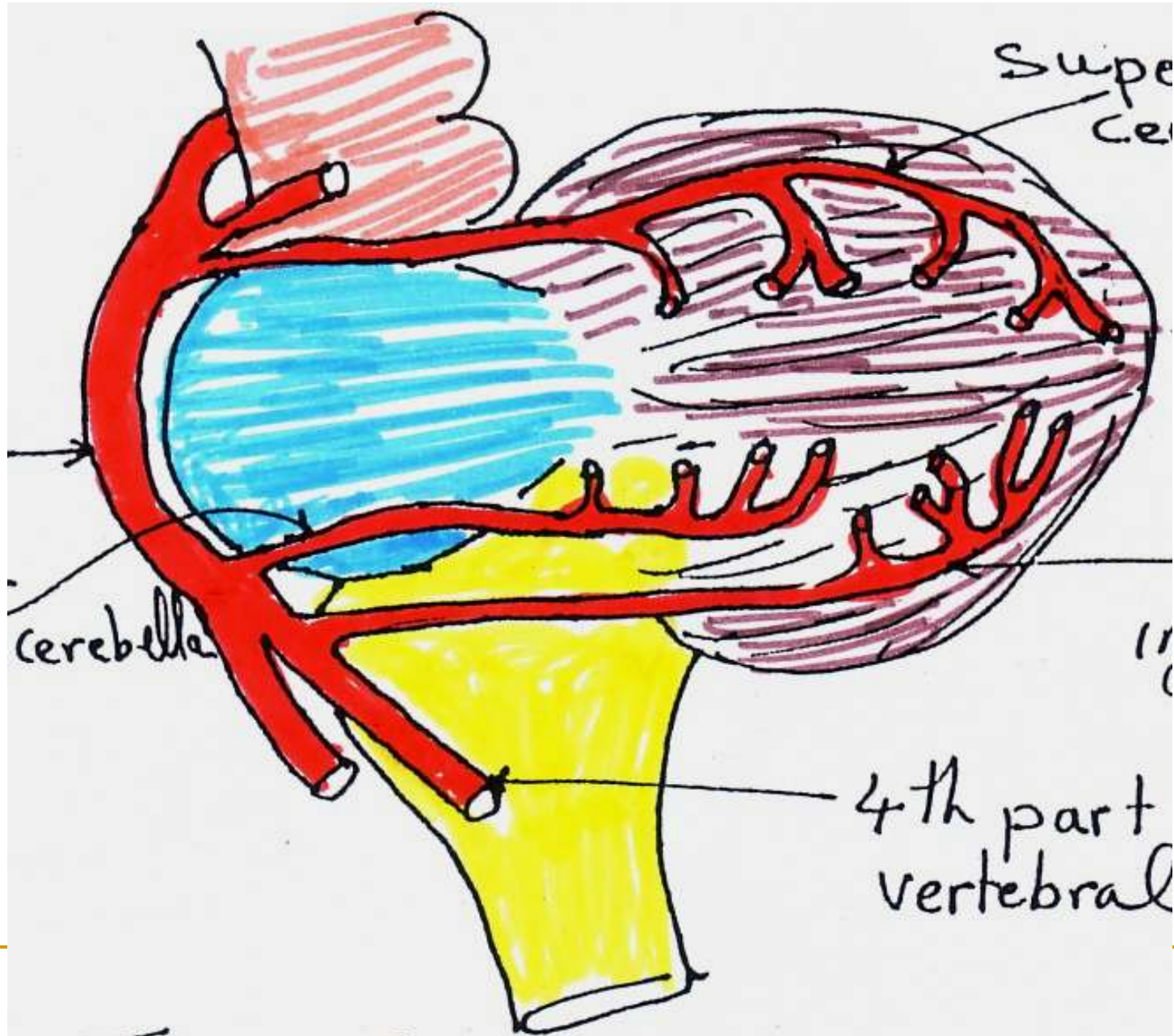


Arteries on the base of the brain injected with resin.

Branches of Basilar artery

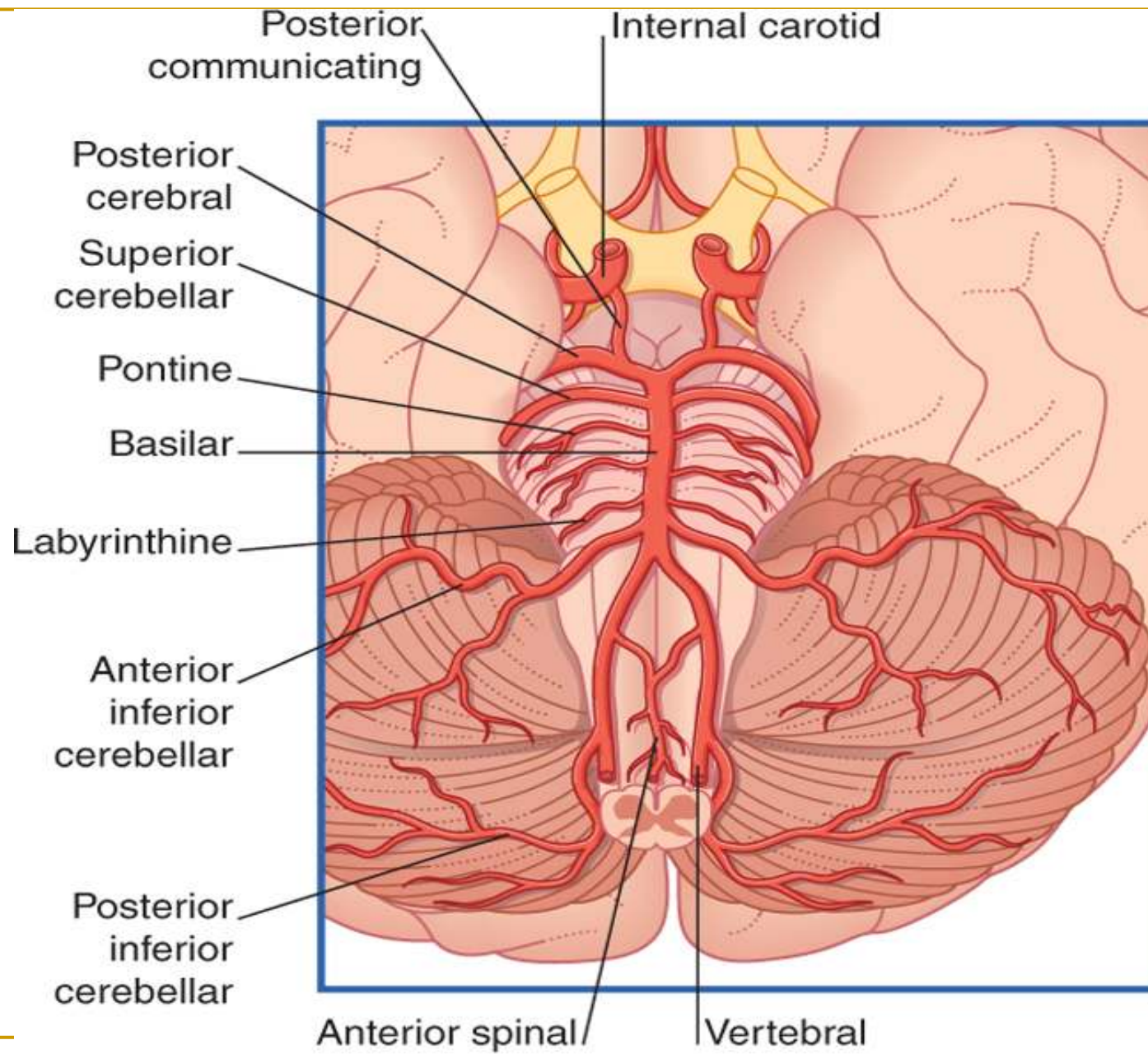


Arteries of the Cerebellum



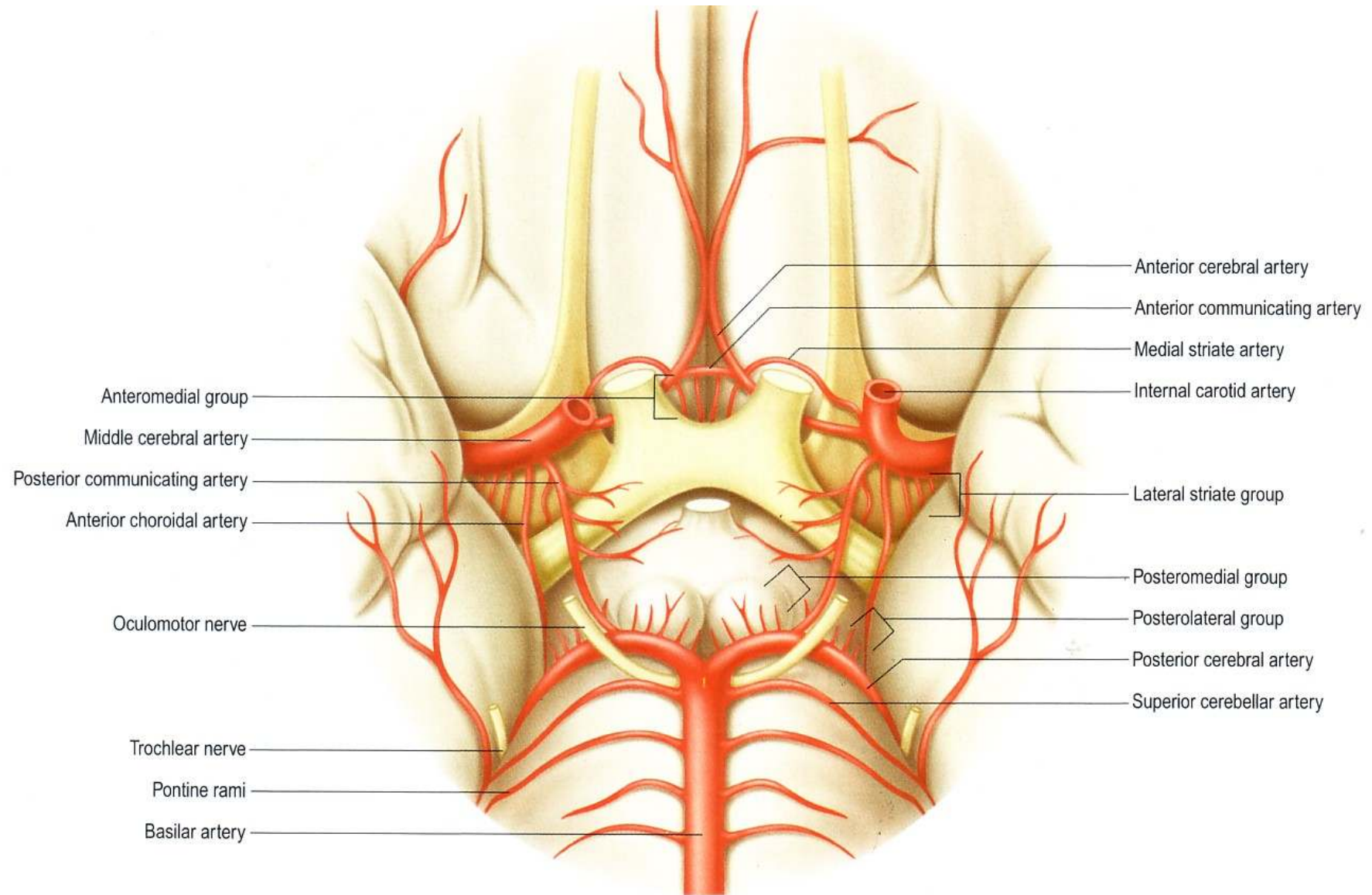
Posterior Cerebral Artery

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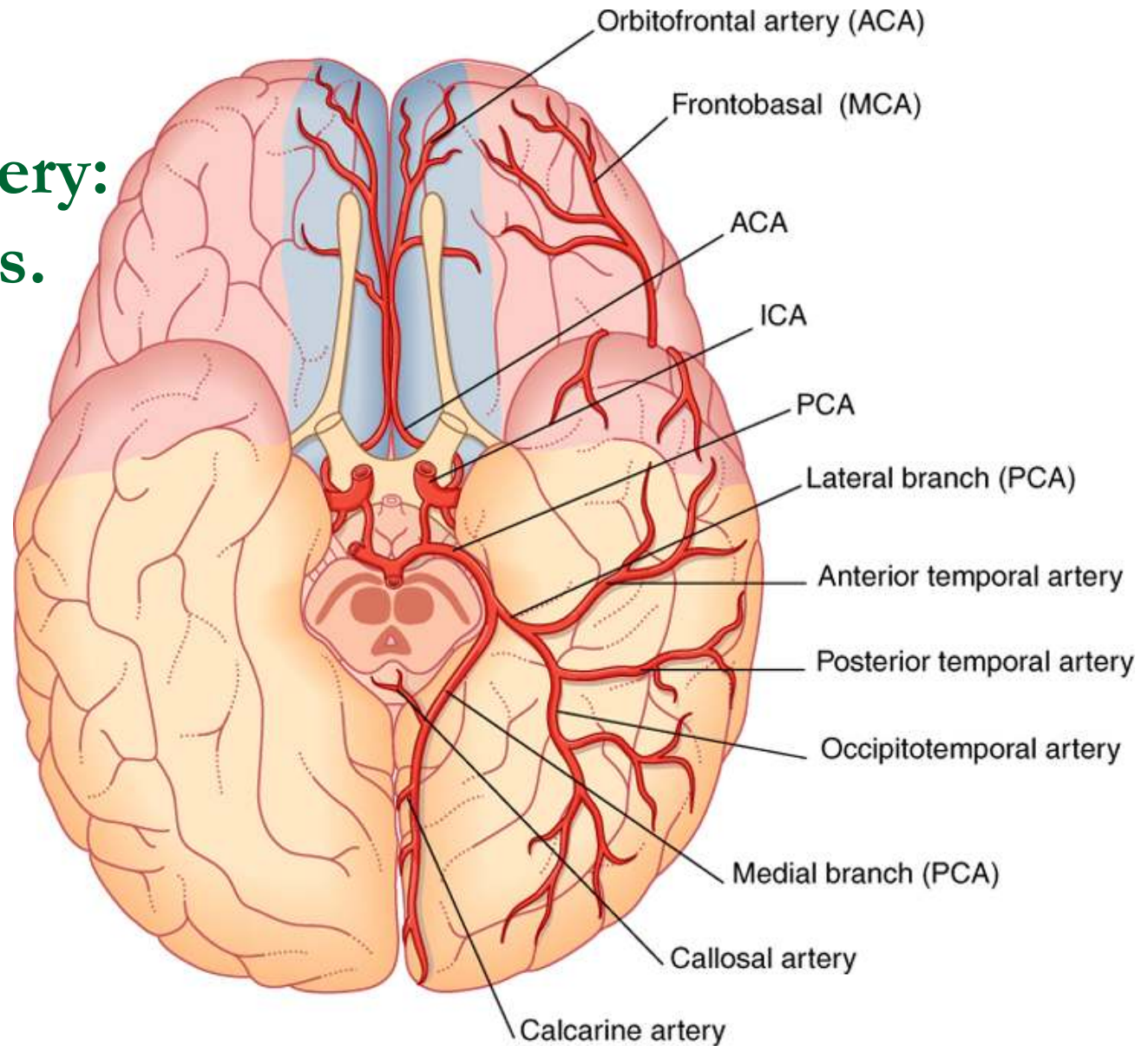


Arterial supply of hindbrain.

Posterior Cerebral artery: Course

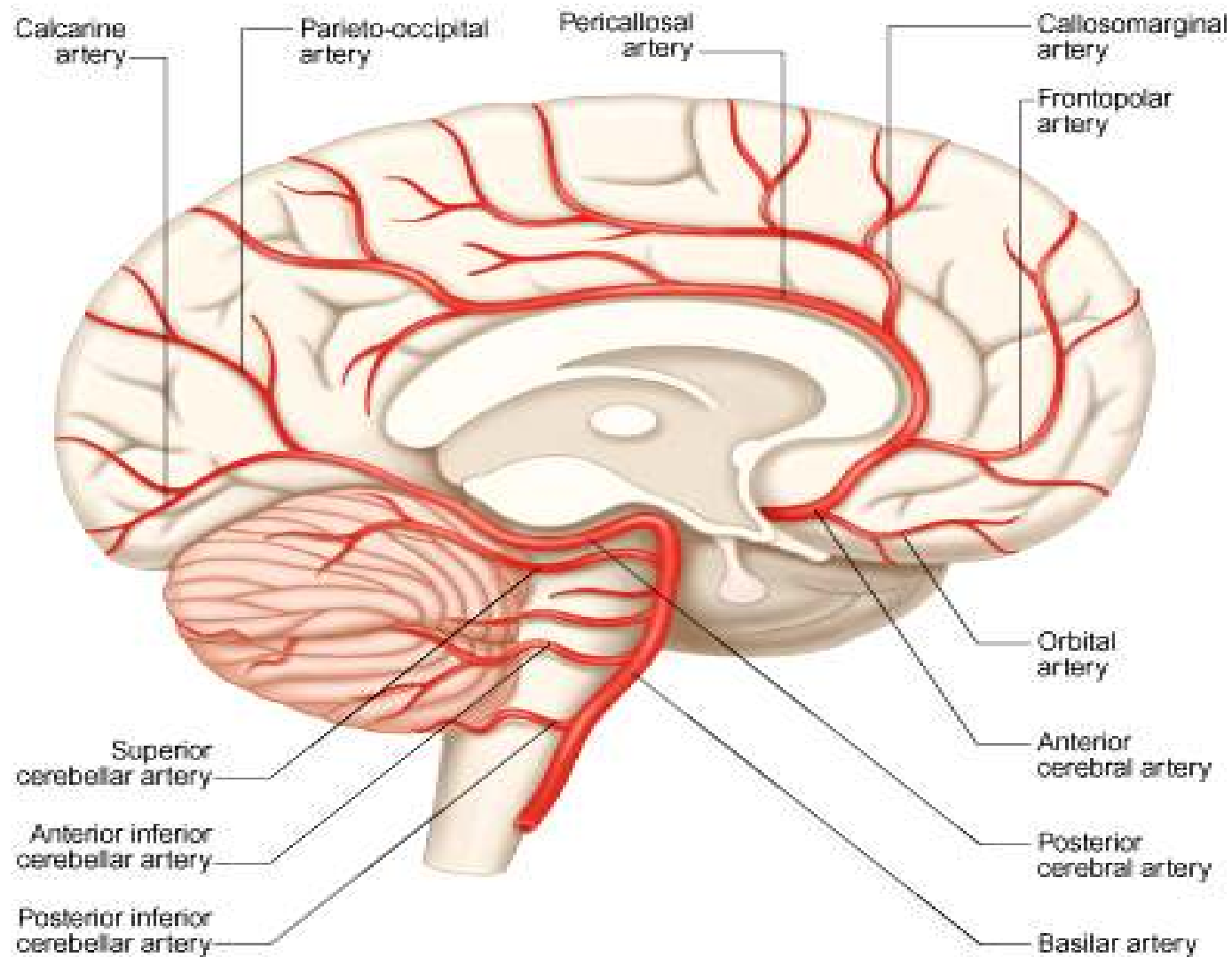


Posterior Cerebral Artery: Course & brs.



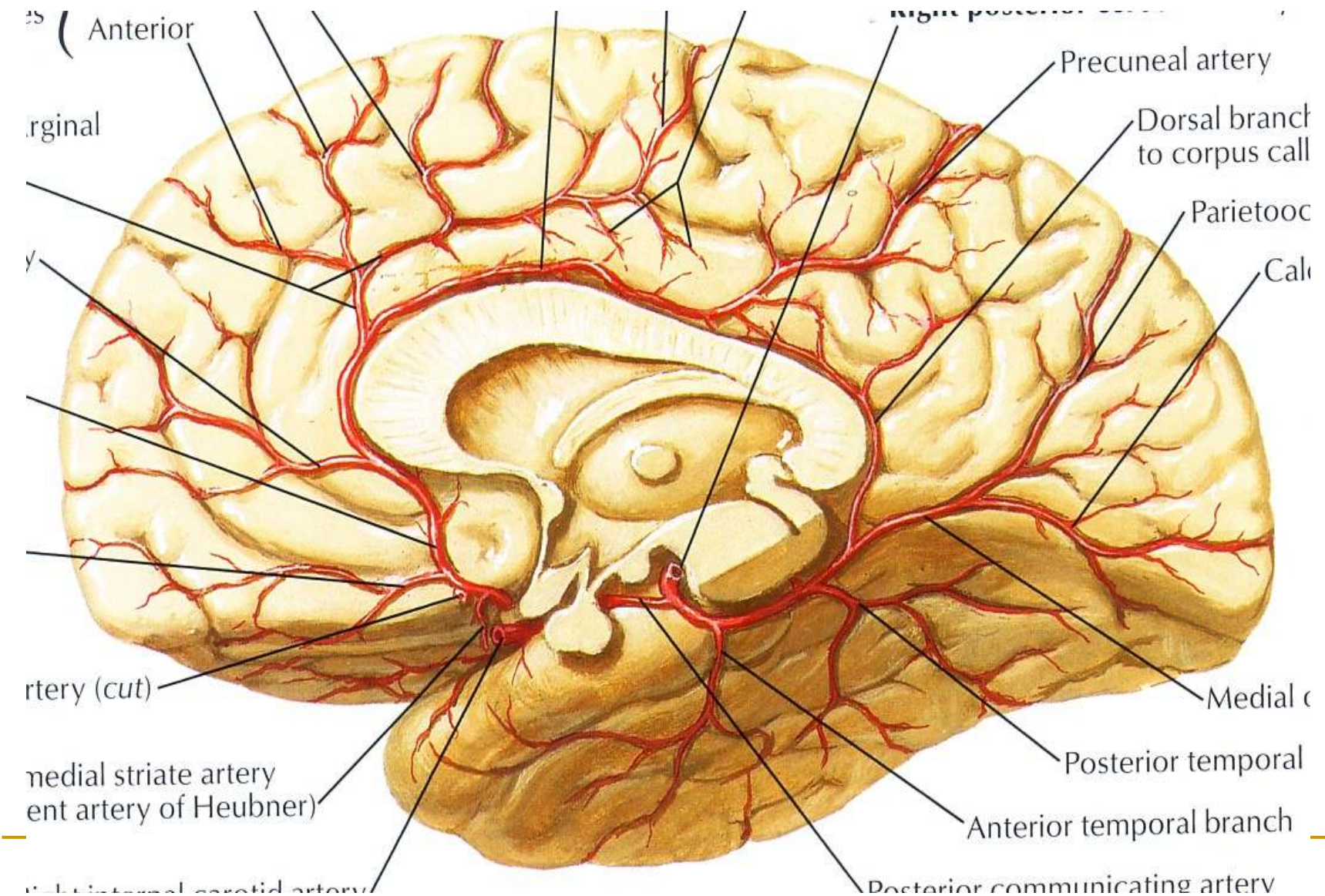
View from below the cerebral hemispheres, showing the cortical branches and territories of the three cerebral arteries.
ACA, MCA, PCA, anterior, middle, posterior cerebral arteries; ICA, internal carotid artery.

Posterior Cerebral Artery: Course

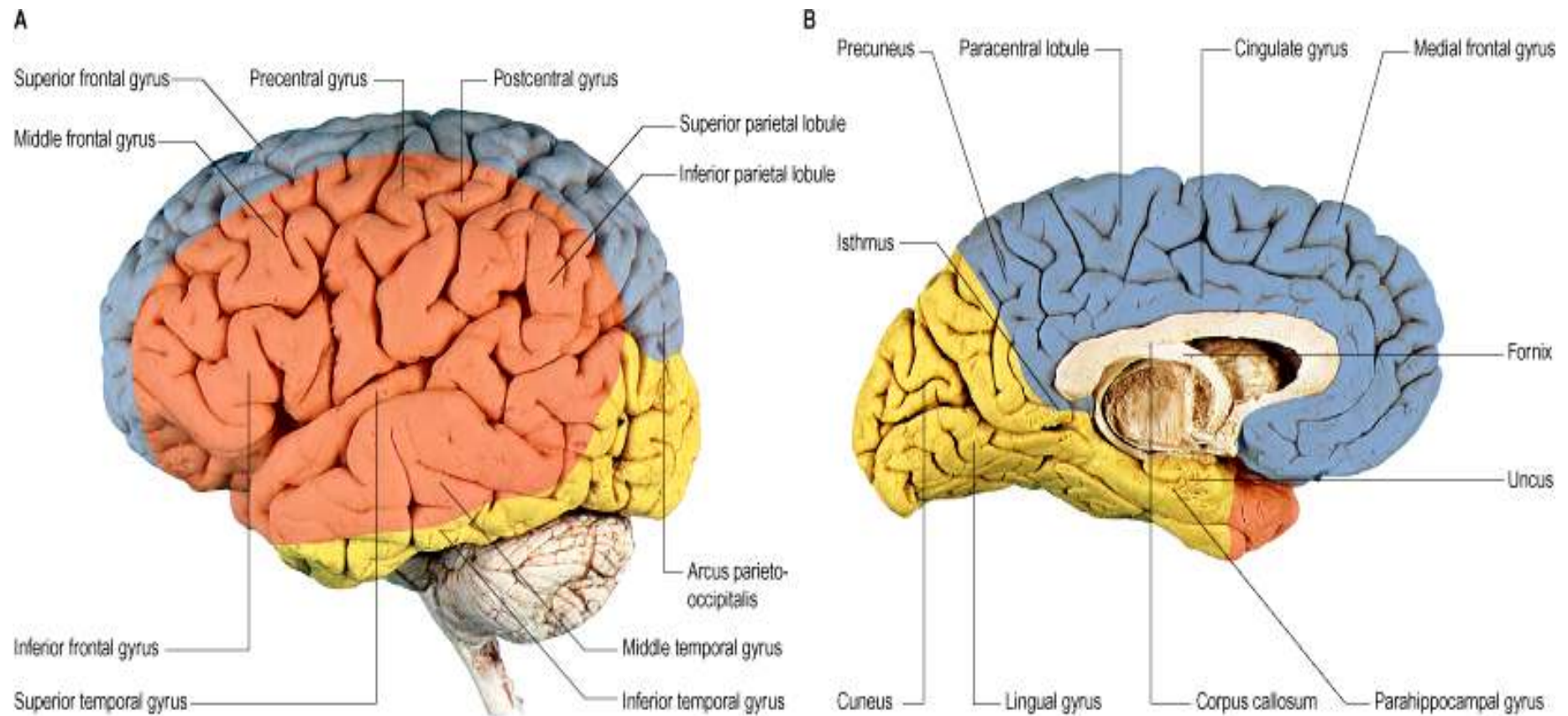


Major arteries of the brain. A, medial aspect

Posterior Cerebral artery: Course



Posterior Cerebral Artery: Brs & Cortical Distribution



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The lateral surface of the left cerebral hemisphere, showing the areas supplied by the cerebral arteries.

B, The medial surface of the left cerebral hemisphere, showing the areas supplied by the cerebral arteries. In these figures the area supplied by the anterior cerebral artery is coloured blue, that by the middle cerebral artery pink and that by the posterior cerebral artery is yellow.

Named cortical branches of the posterior cerebral artery

Branch	Artery	Territory
Lateral	Anterior temporal	Anterior temporal cortex
	Posterior temporal	Posterior temporal cortex
	Occipitotemporal	Posterior temporal and occipital cortex
Medial	Calcarine	Calcarine cortex
	Parietooccipital	Cuneus and precuneus
	Callosal	Splenium of corpus callosum

Posterior Cerebral Artery: Important Areas of Cortical Distribution

LOBE	AREA
OCCIPITAL	Visual
TEMPORAL	Olfactory

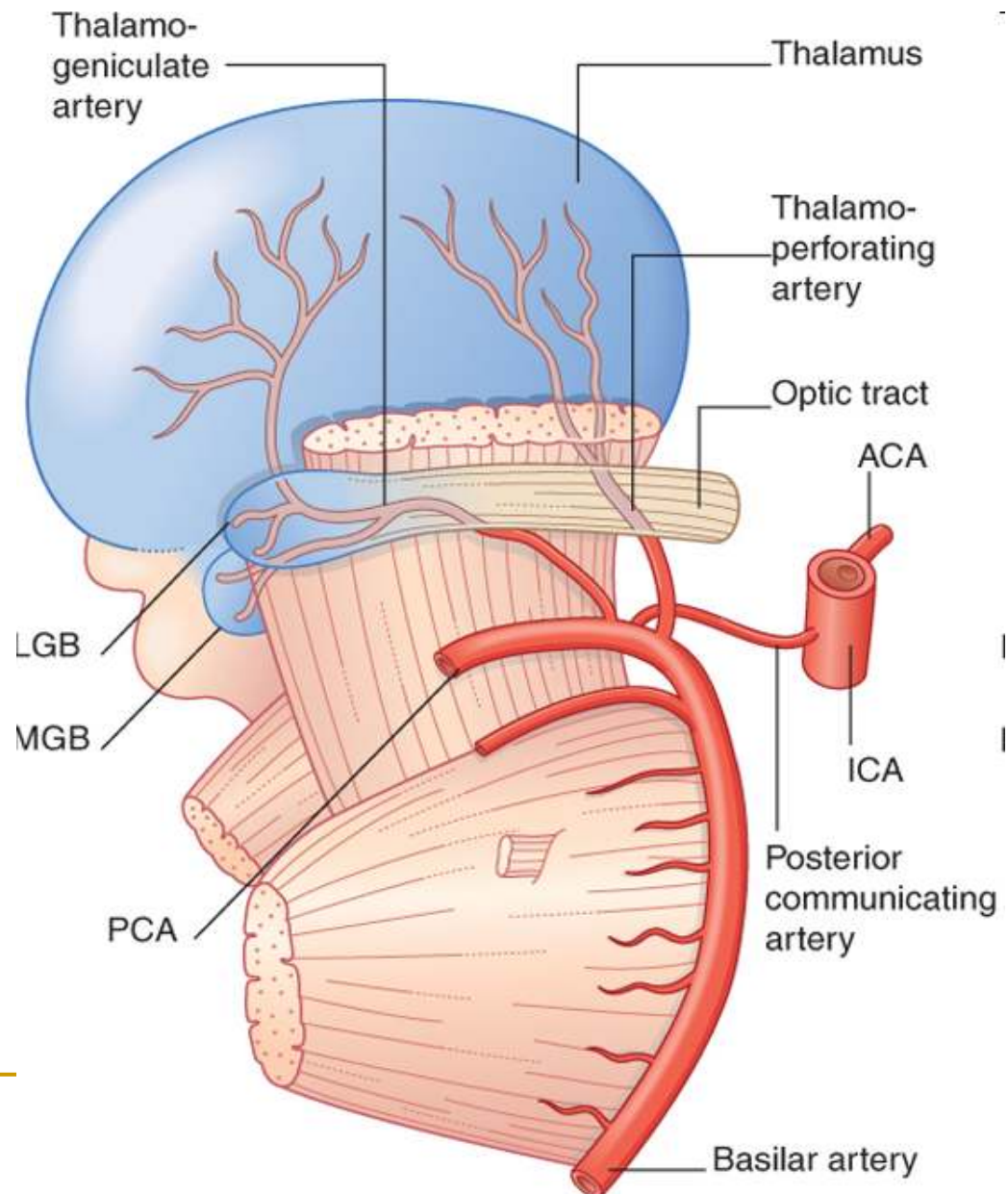
Posterior Cerebral Artery: Central Brs

1- Posteromedial Group

pierce the posterior perforated substance and supply:

- **The thalamoperforating artery** to the anterior one-third of the thalamus
- Hypothalamus
- Globus Pallidus

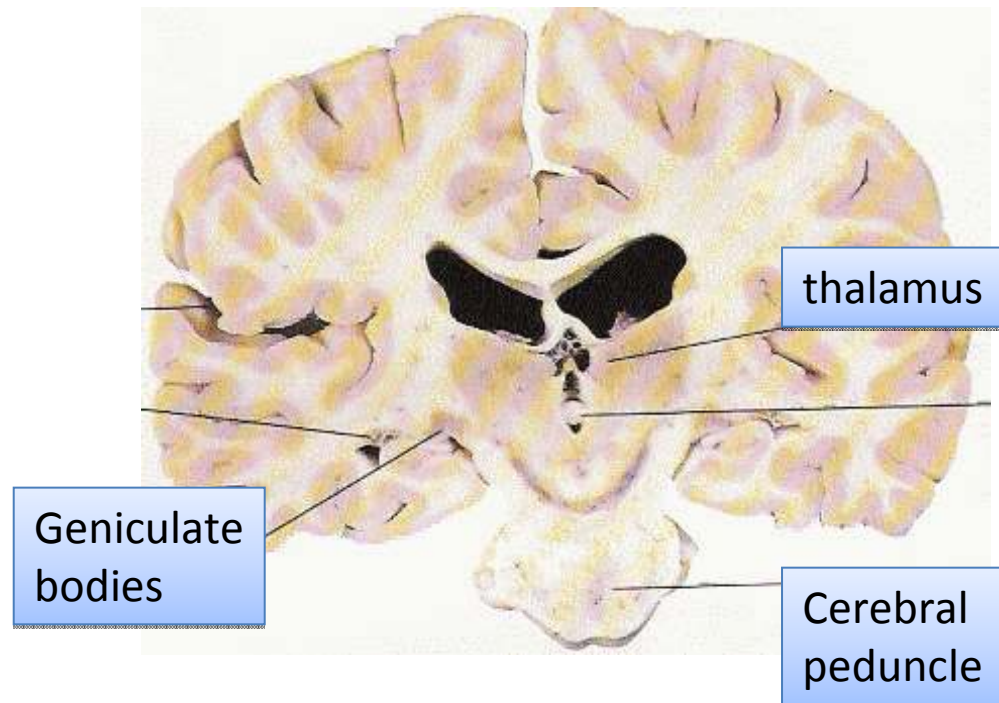
ACA, anterior cerebral artery; ICA, internal carotid artery; LGB, MGB, lateral, medial geniculate bodies .



Posterior Cerebral Artery: Central Brs

2- Posterolateral Group

1. The **thalamogeniculate artery** shown supplies the geniculate bodies and the posterior two-thirds of the thalamus.
2. Brs. To the cerebral peduncles & Tectum of the Midbrain



Posterior Cerebral Artery: Choroidal Brs

- **posterior choroidal artery: from the posterior cerebral artery** to supply the choroid plexus of the lateral ventricle .

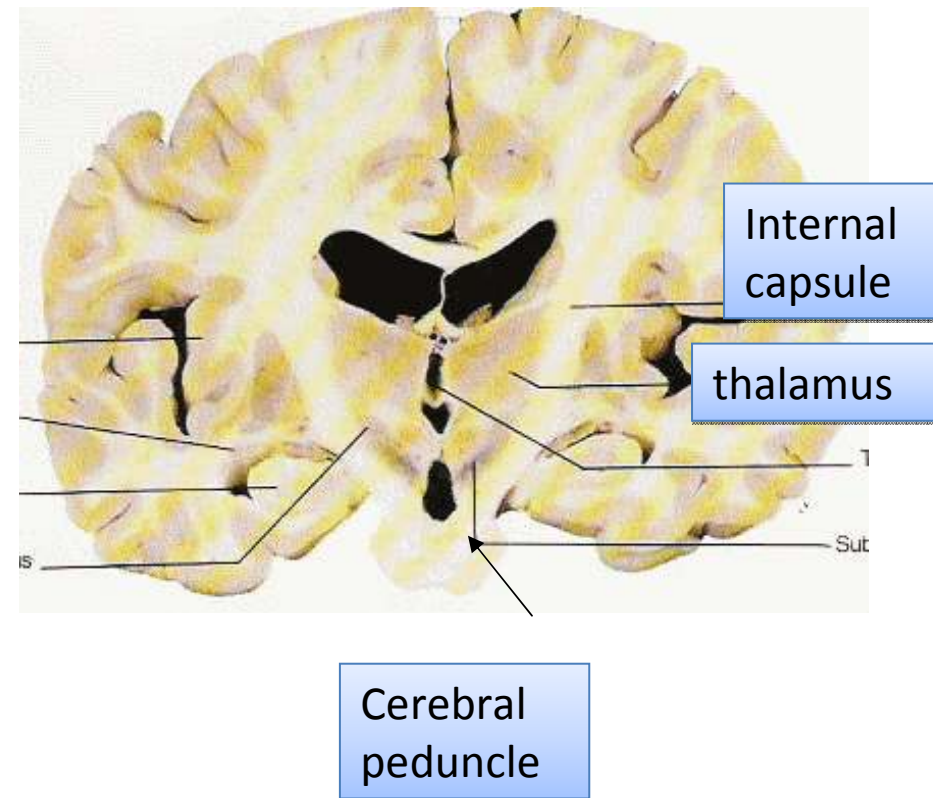
Posterior cerebral artery & posterior communicating artery

Central brs

Hypothalamus

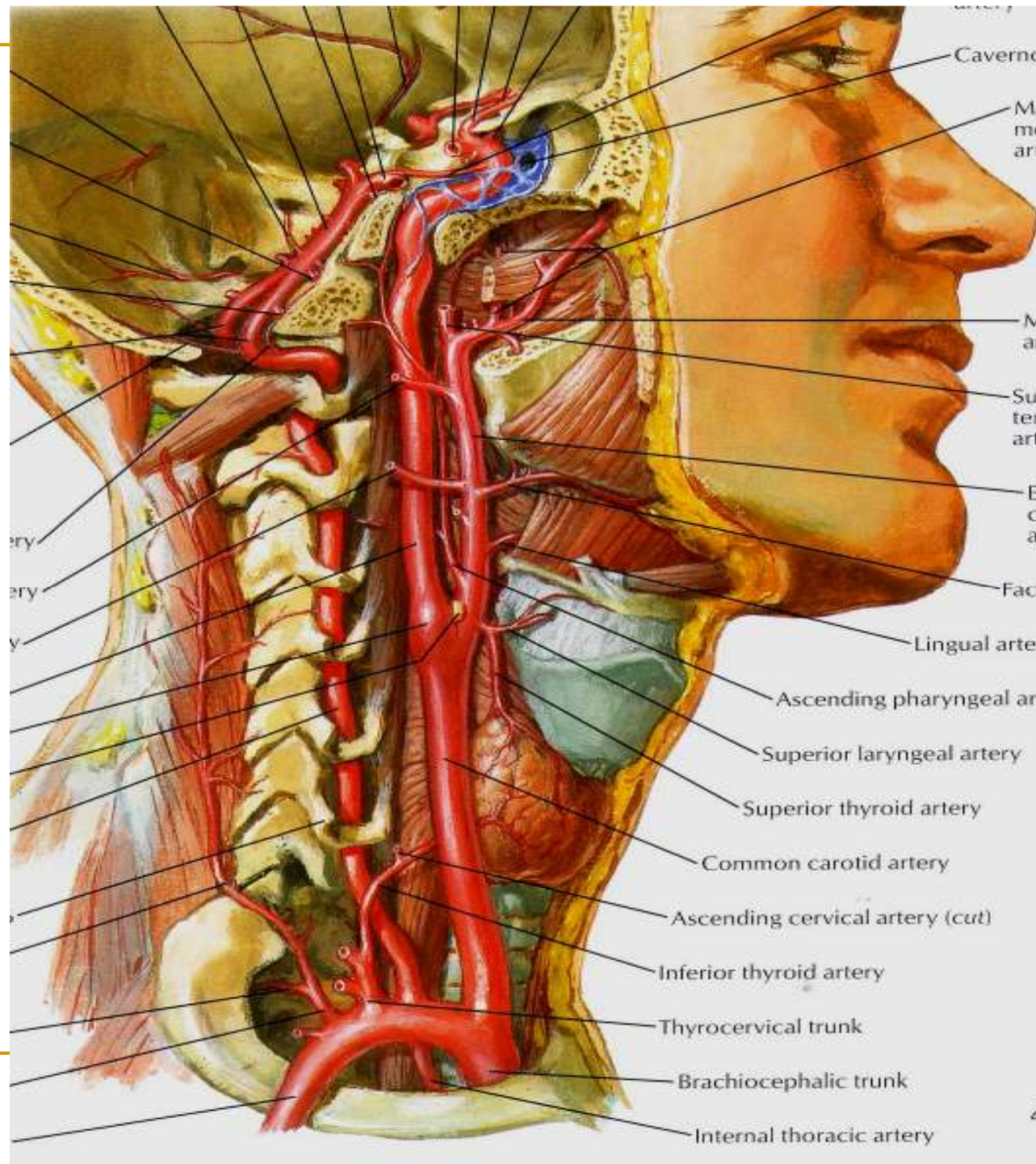
Thalamus (ANT)

Cerebral peduncle



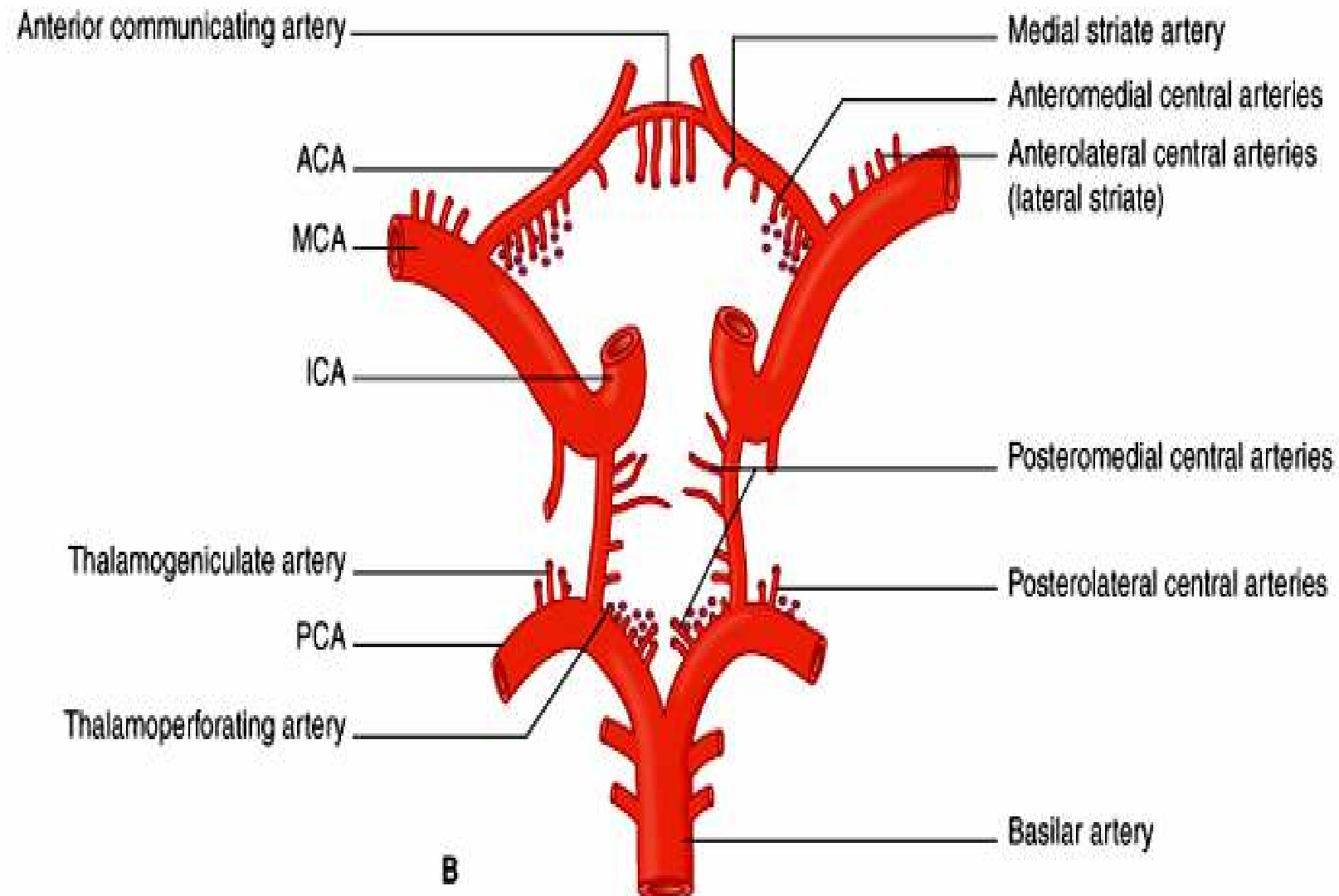
Internal Carotid System

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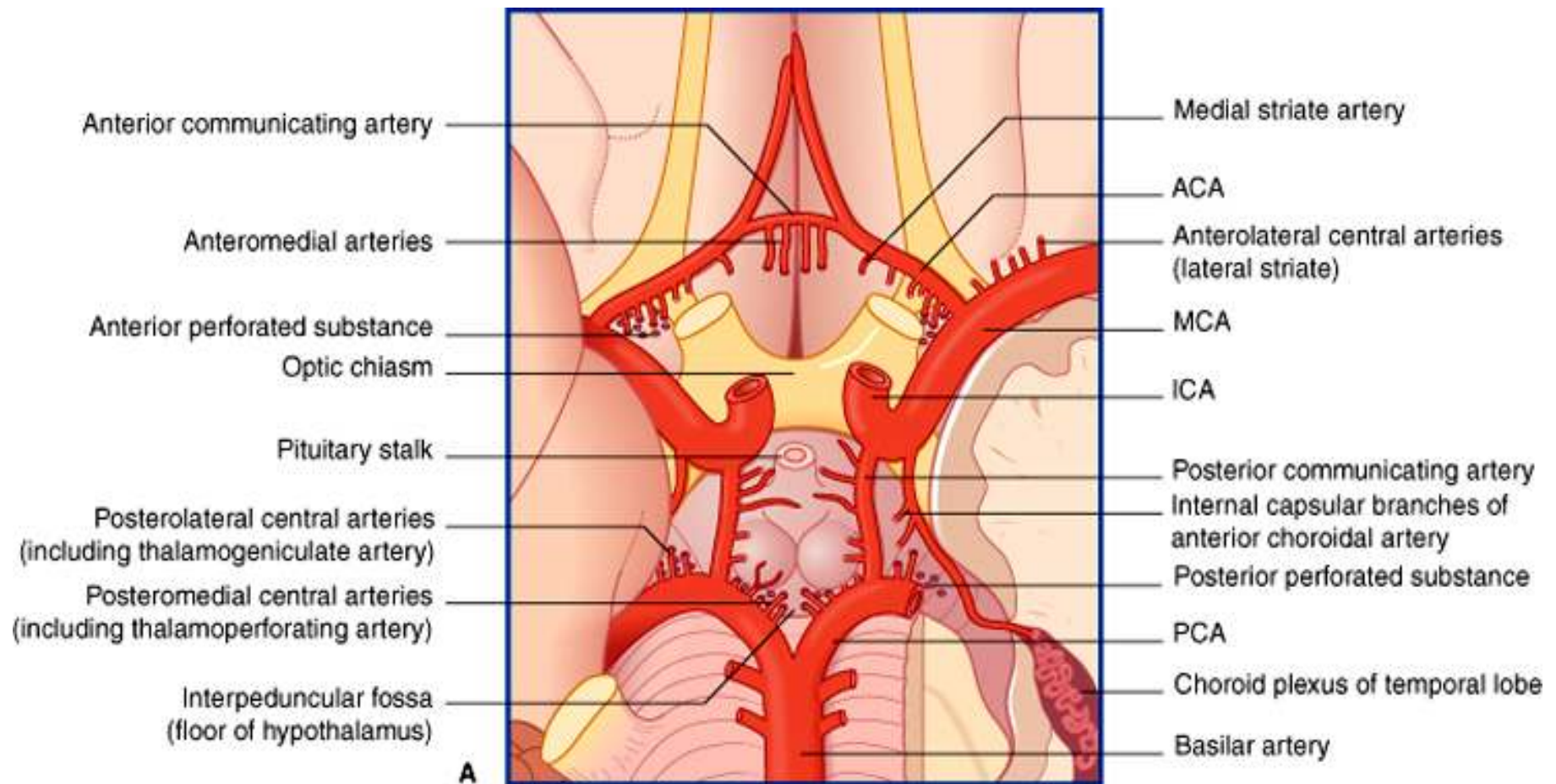


Internal Carotid Artery

- Begins – bifurcation of Common Carotid A
 - Enters middle cranial fossa through the carotid canal at the base of skull
 - Lies beside dorsum sellae
 - In the cavernous sinus: Lies **Horizontal**
 - Emerge out – medial side of Ant. clinoid process – perforates dura & arachnoid mater – enters subarachnoid space
 - Turns posteriorly – below optic nerve
 - Turns upward – lateral to optic chiasma
 - Now is under anterior perforated substance
 - Divides – into ***ANTERIOR & MIDDLE*** cerebral arteries
-



The arteries comprising the circle of Willis. The four groups of central branches are shown; the thalamoperforating artery belongs to the posteromedial group, and the thalamogeniculate artery belongs to the posterolateral group. ACA, MCA, PCA, anterior, middle, posterior cerebral arteries; ICA, internal carotid artery.



Brain viewed from below, showing background structures related to the circle of Willis. Part of the left temporal lobe (to right of picture) has been removed to show the choroid plexus in the inferior horn of the lateral ventricle

■ Internal Carotid A

- ❑ Hypophyseal arteries
- ❑ Ophthalmic
- ❑ Anterior communicating
- ❑ Post Communicating
- ❑ Anterior Choroidal
- ❑ Ant Cerebral
 - Cortical
 - Central
 - Communicates with
 - ❑ Ant. Comm. A.
- ❑ Middle Cerebral
 - Cortical
 - Central

■ Vertebral A.

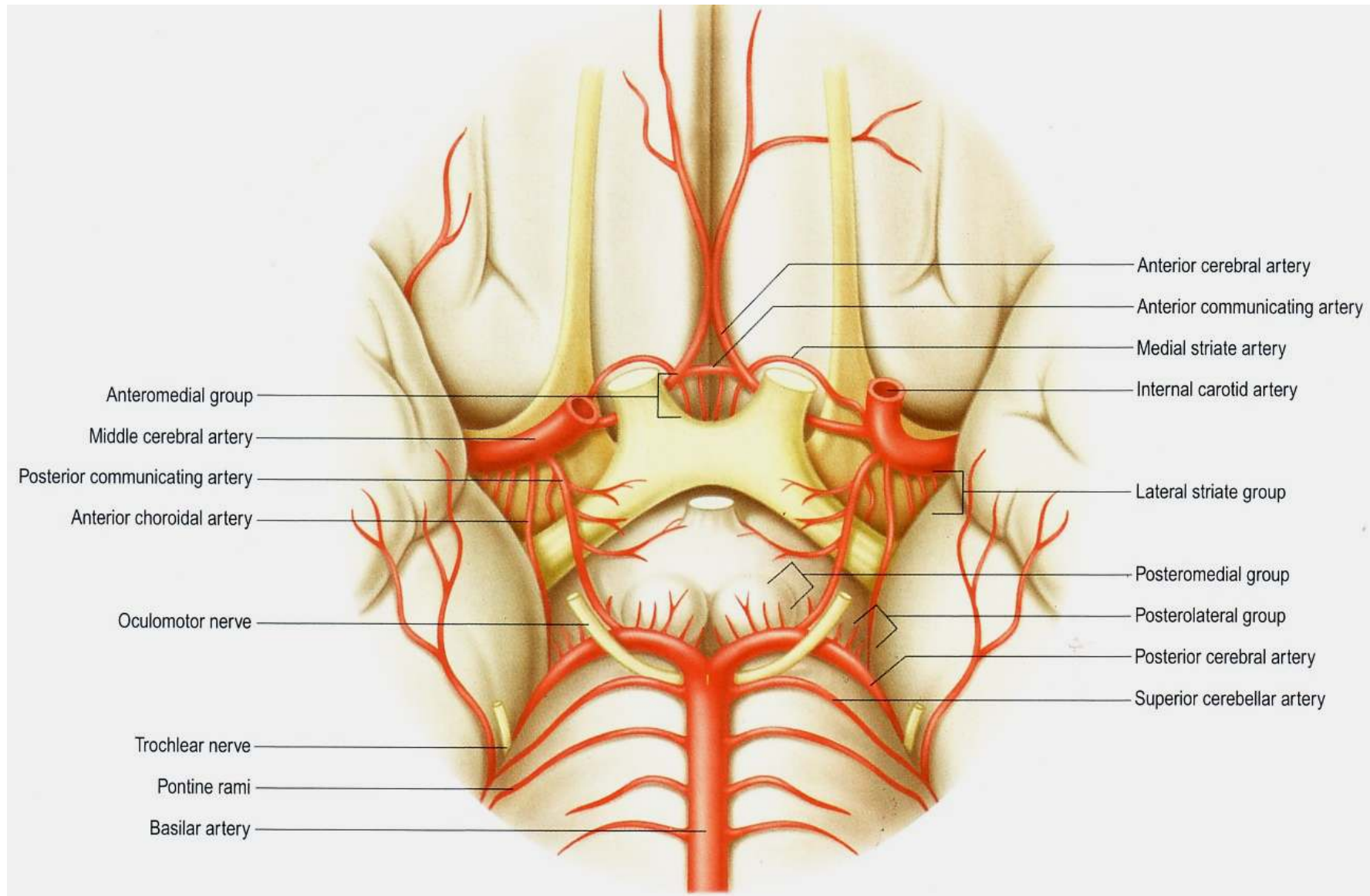
- ❑ Meningeal
- ❑ Post Spinal
- ❑ Ant Spinal
- ❑ Post Inf Cerebellar
- ❑ Medullary

■ Basilar A.

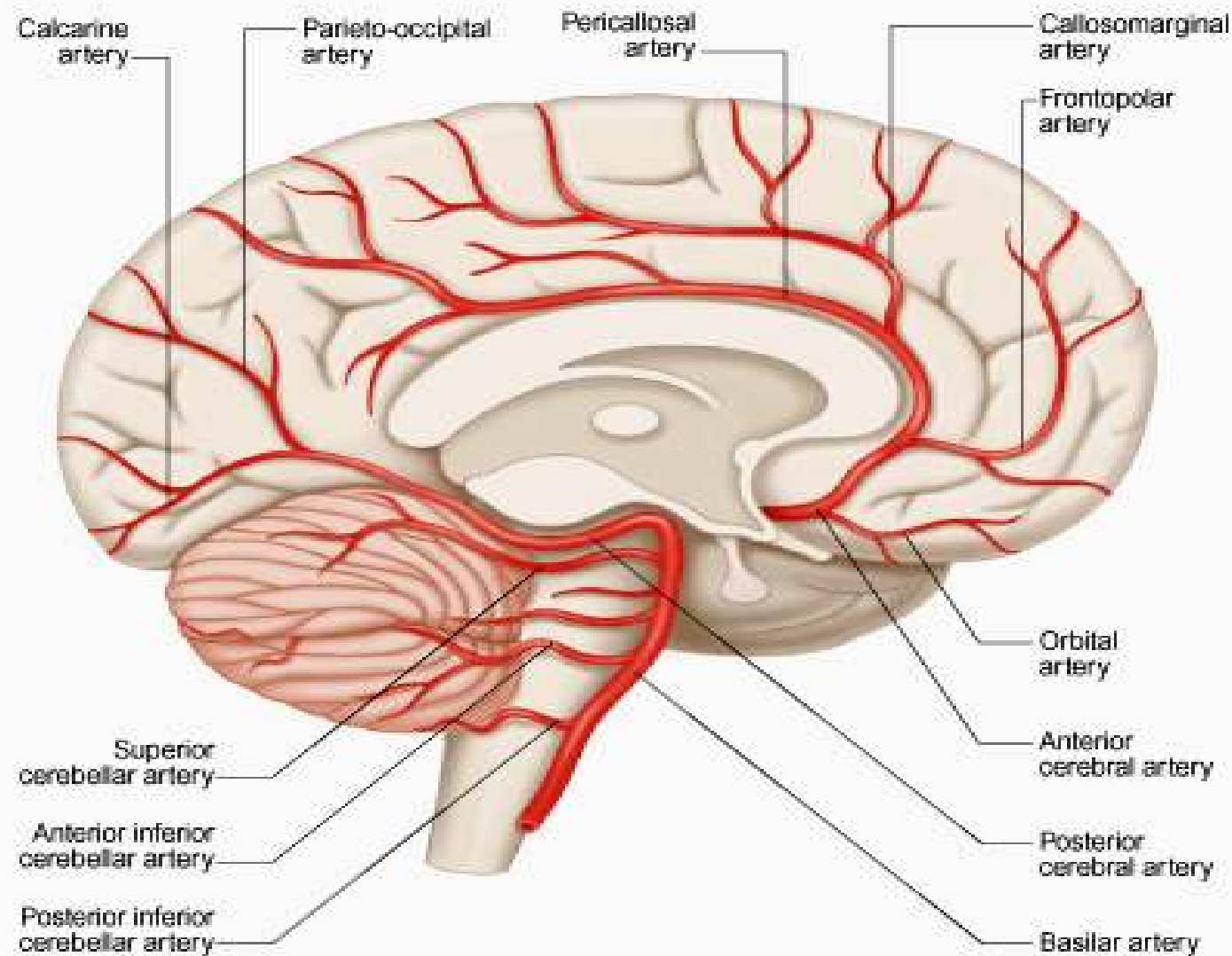
- ❑ Pontine
 - ❑ Labyrinthine
 - ❑ Ant. Inf. Cerebellar
 - ❑ Sup. Cerebellar
 - ❑ Post Cerebral
 - Cortical
 - Central
 - Choroidal
-

Anterior Cerebral Artery

Anterior Cerebral artery: Course

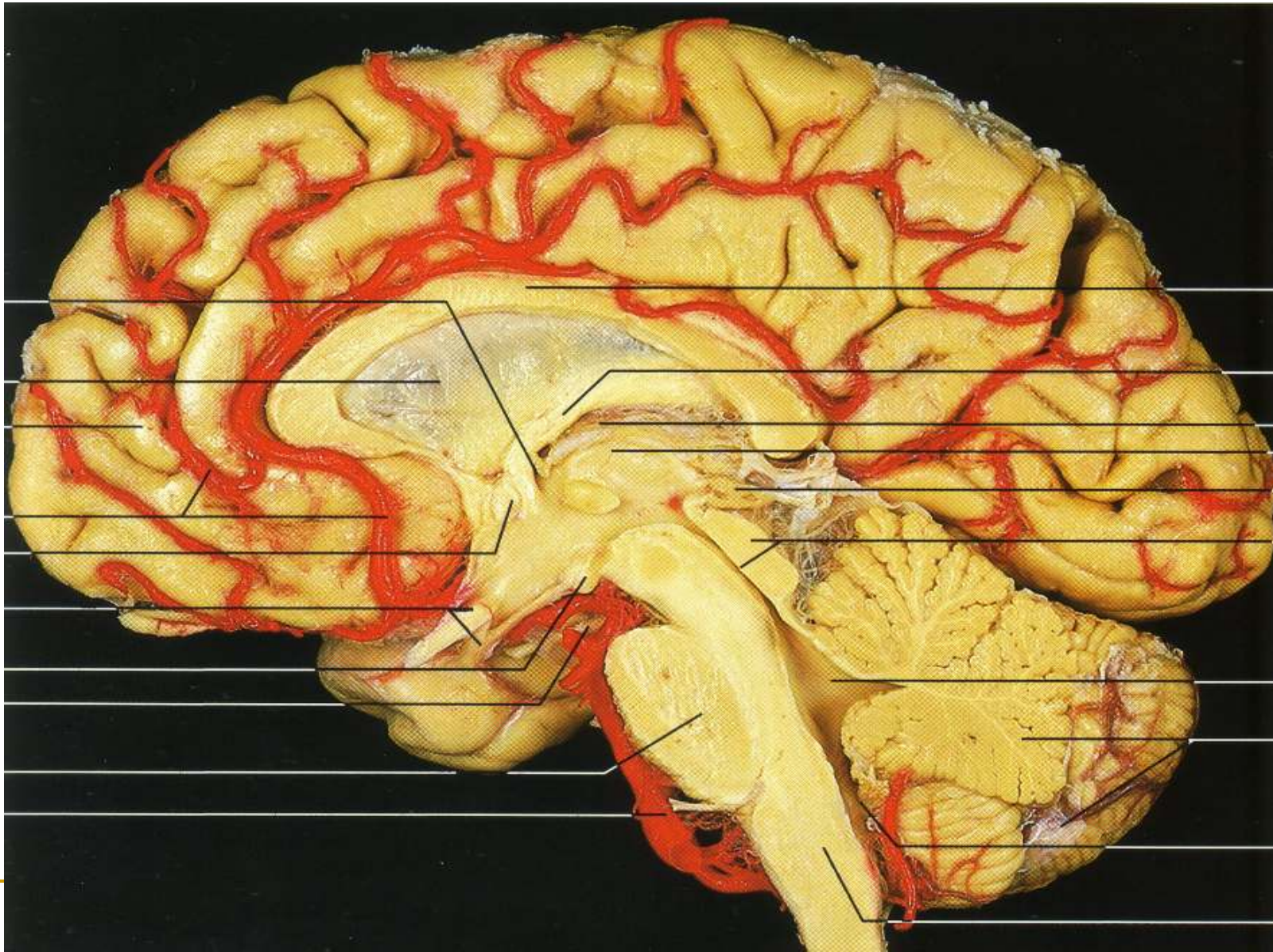


Anterior Cerebral Artery: Course

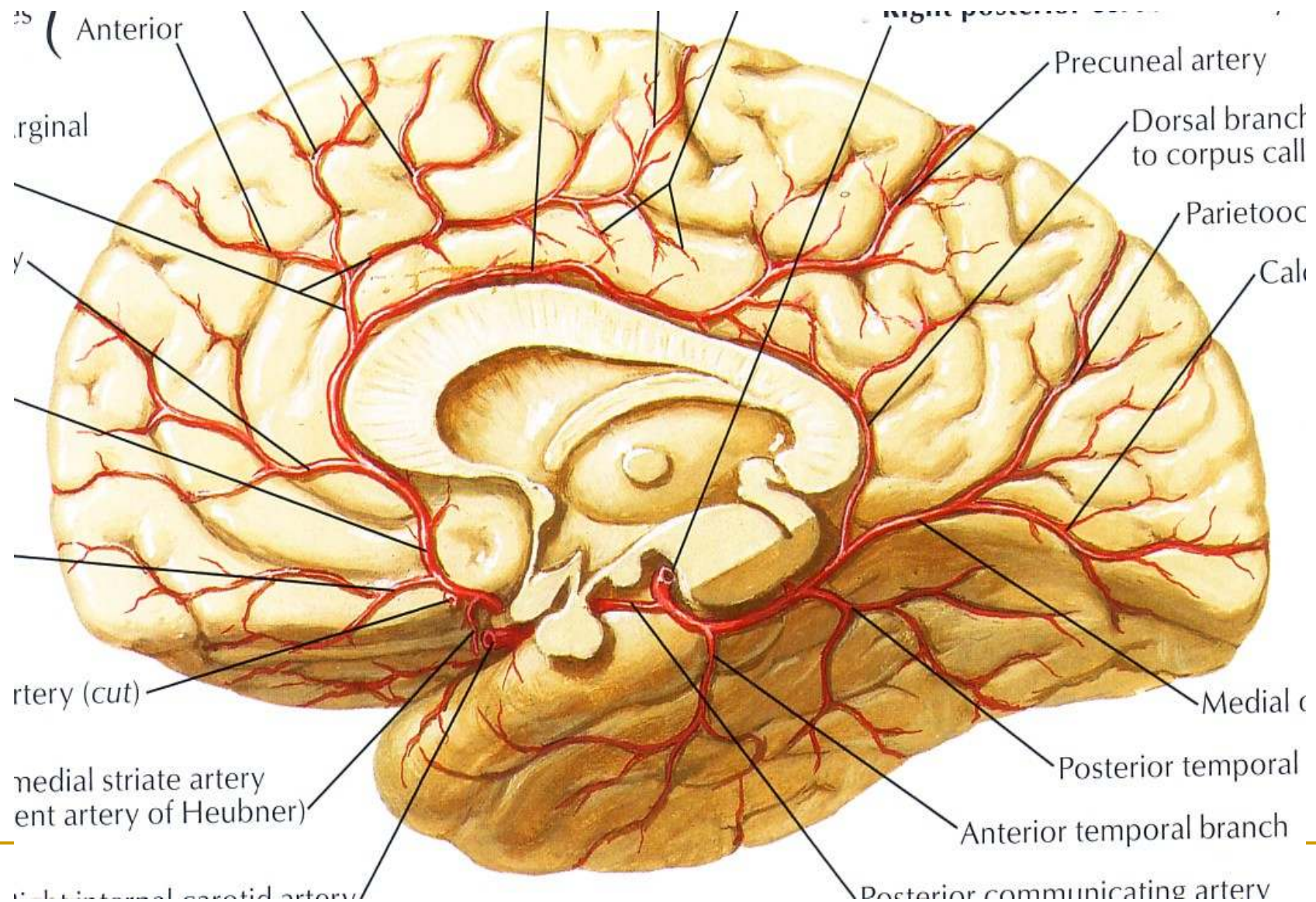


Major arteries of the brain. A, medial aspect

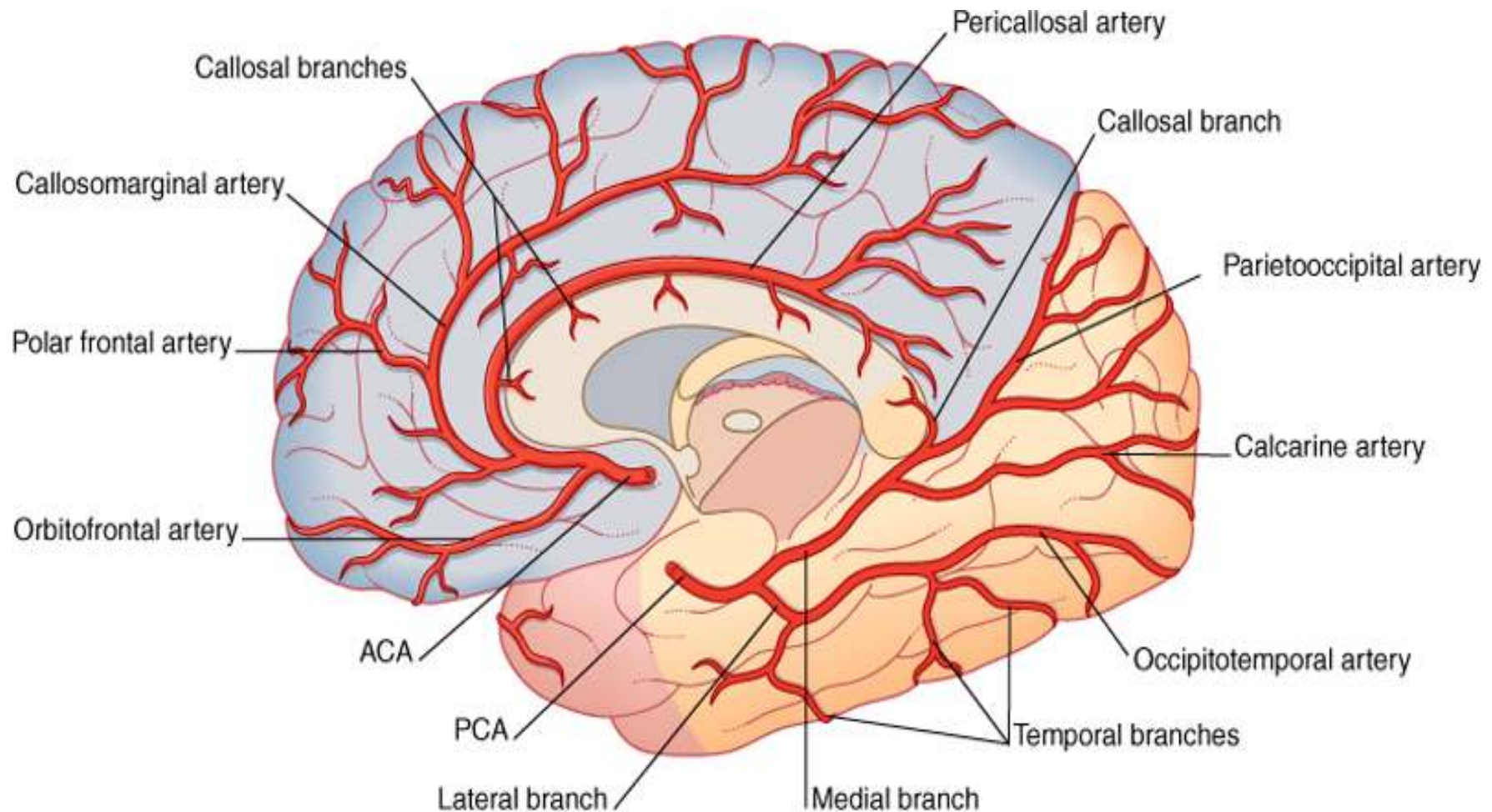
Anterior Cerebral artery: Course



Anterior Cerebral artery: Course



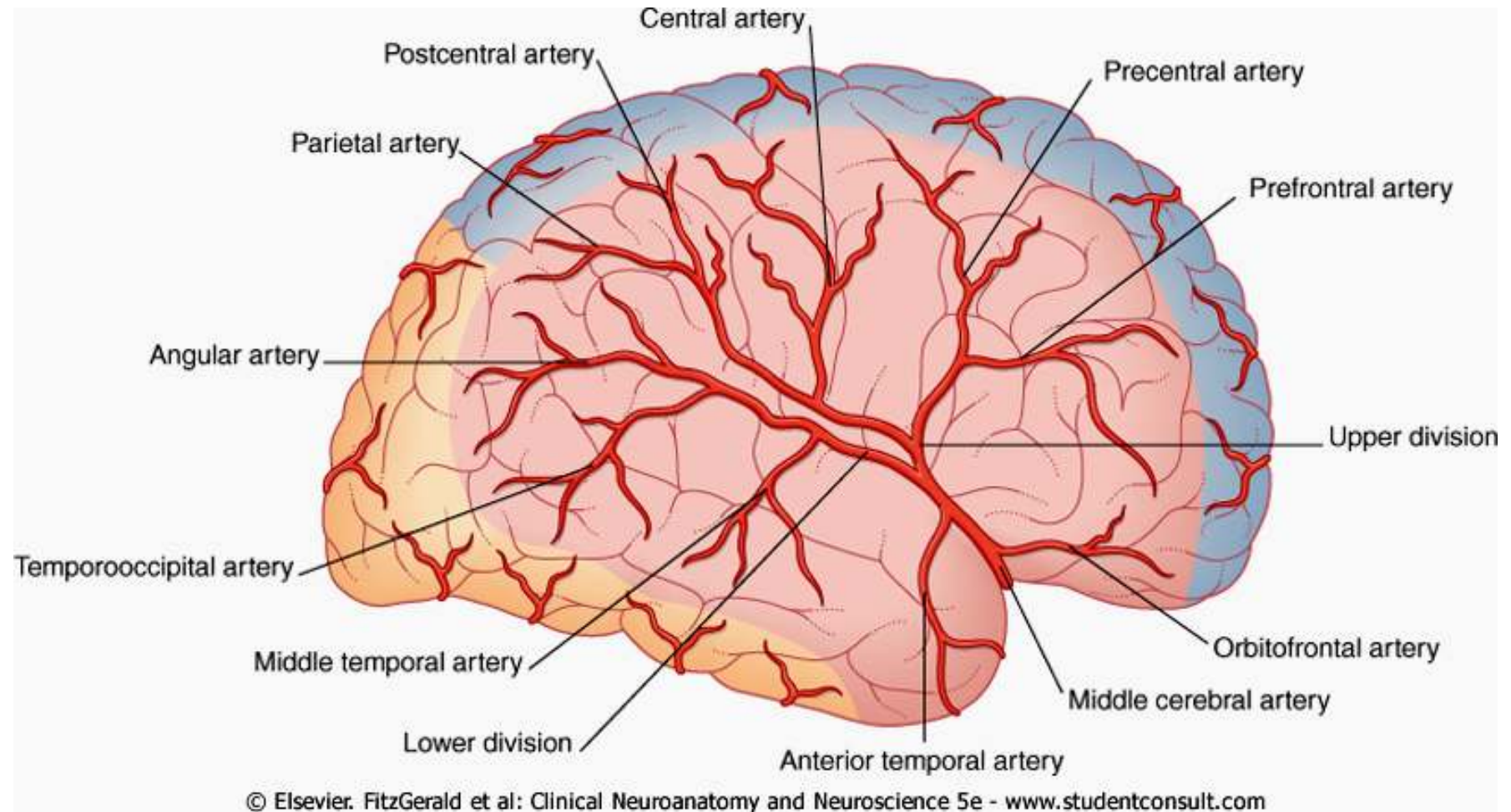
Anterior Cerebral Artery: Cortical brs.



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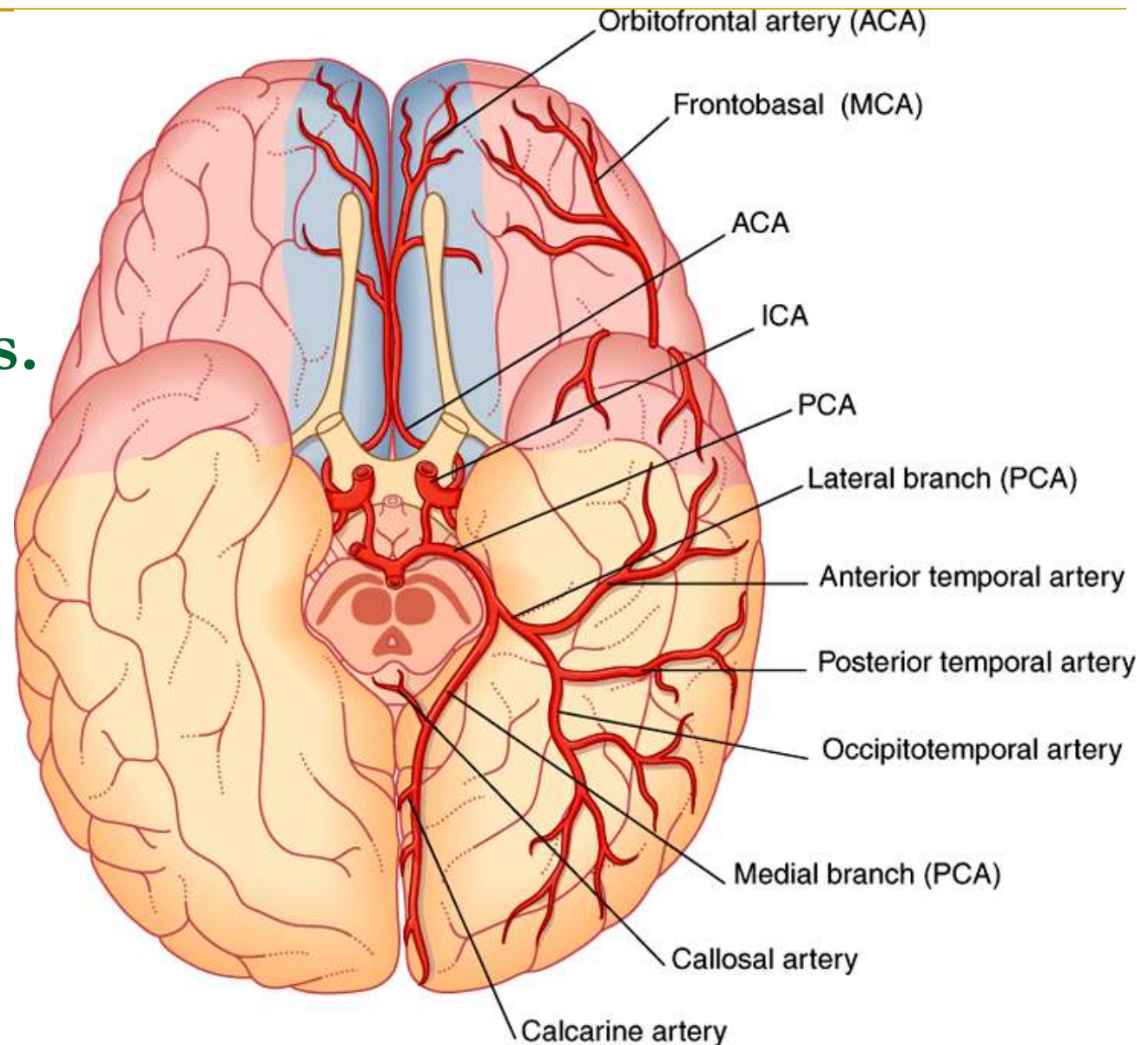
Medial view of the right hemisphere, showing the cortical branches and territories of the three cerebral arteries. ACA, PCA, anterior, posterior cerebral arteries.

Anterior Cerebral Artery: Cortical brs.



Lateral view of right cerebral hemisphere, showing the cortical branches and territories of the three cerebral arteries.

Anterior Cerebral Artery: Cortical brs.



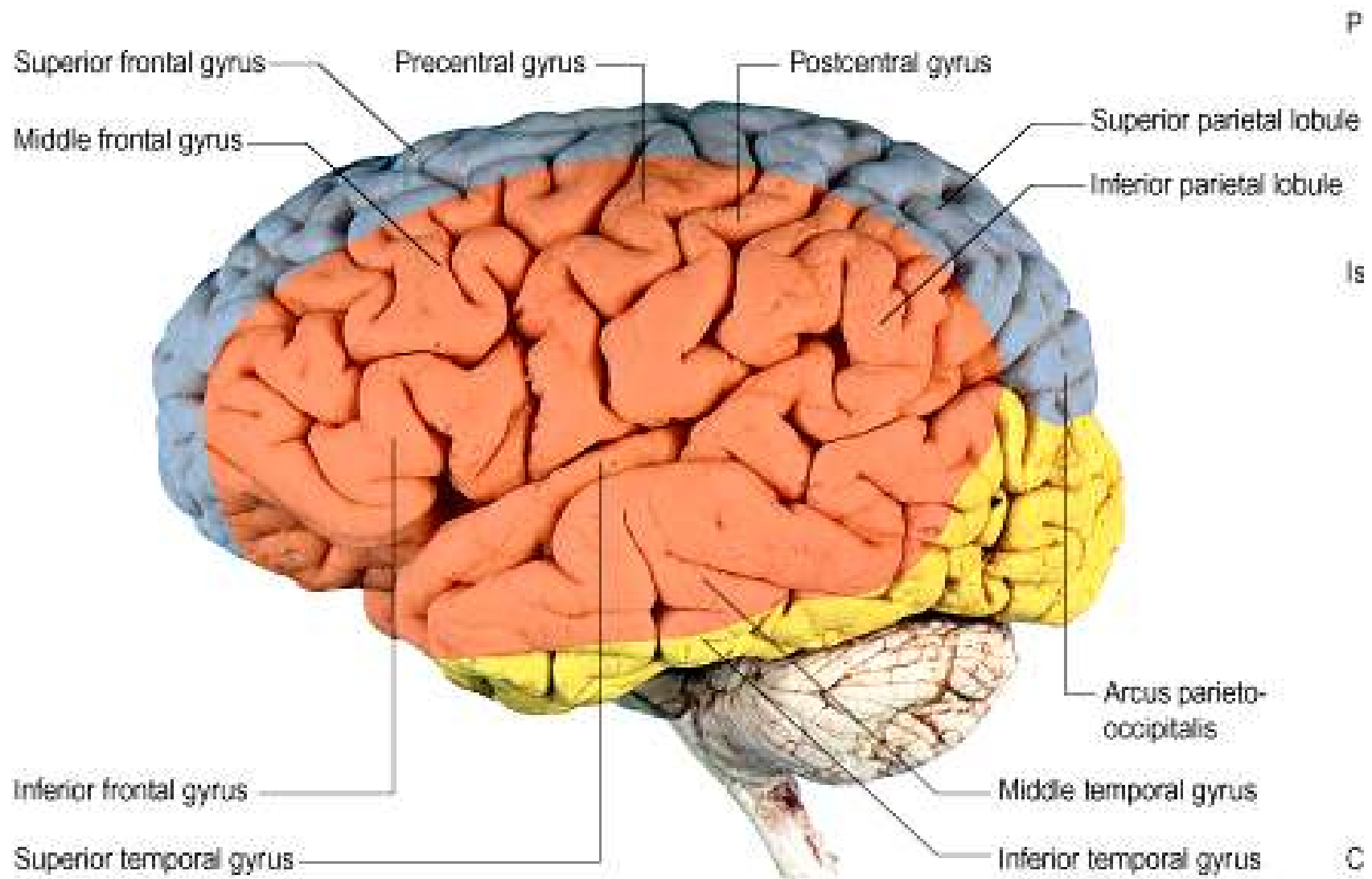
View from below the cerebral hemispheres, showing the cortical branches and territories of the three cerebral arteries. ACA, MCA, PCA, anterior, middle, posterior cerebral arteries; ICA, internal carotid artery.

Named cortical branches of the anterior cerebral artery

Branch	Territory
Orbitofrontal	Orbital surface of frontal lobe
Polar frontal	Frontal pole
Callosomarginal	Cingulate and superior frontal gyri; paracentral lobule
Pericallosal	Corpus callosum

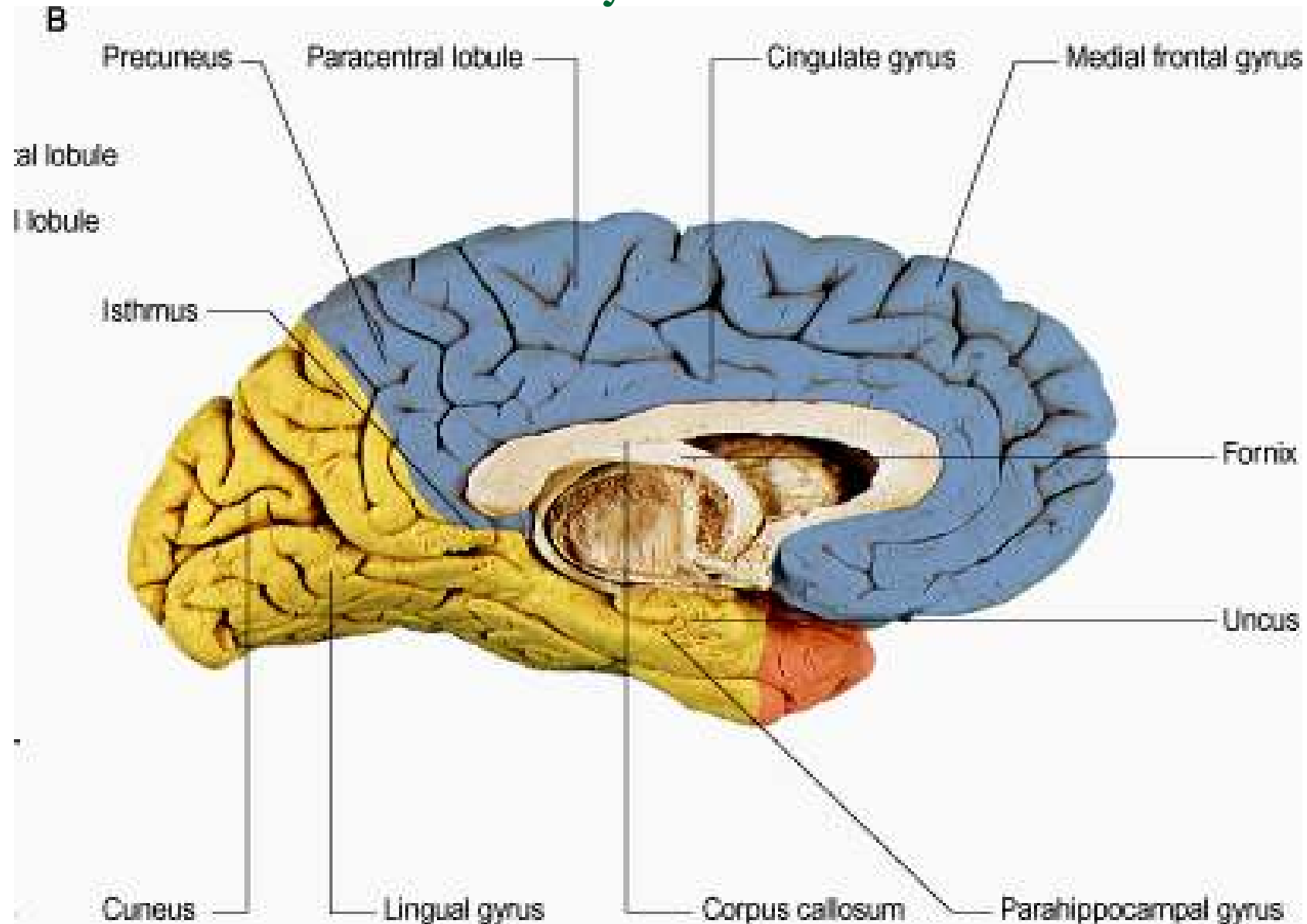
N. B. The term *cortical* is conventional . *Terminal* is better, because these arteries also supply the underlying white matter .

Anterior Cerebral Artery: cortical Distribution



The lateral surface of the left cerebral hemisphere, showing the areas supplied by the cerebral arteries.. In these figures the area supplied by the anterior cerebral artery is coloured blue, that by the middle cerebral artery pink and that by the posterior cerebral artery is yellow.

Anterior Cerebral Artery: Cortical Distribution



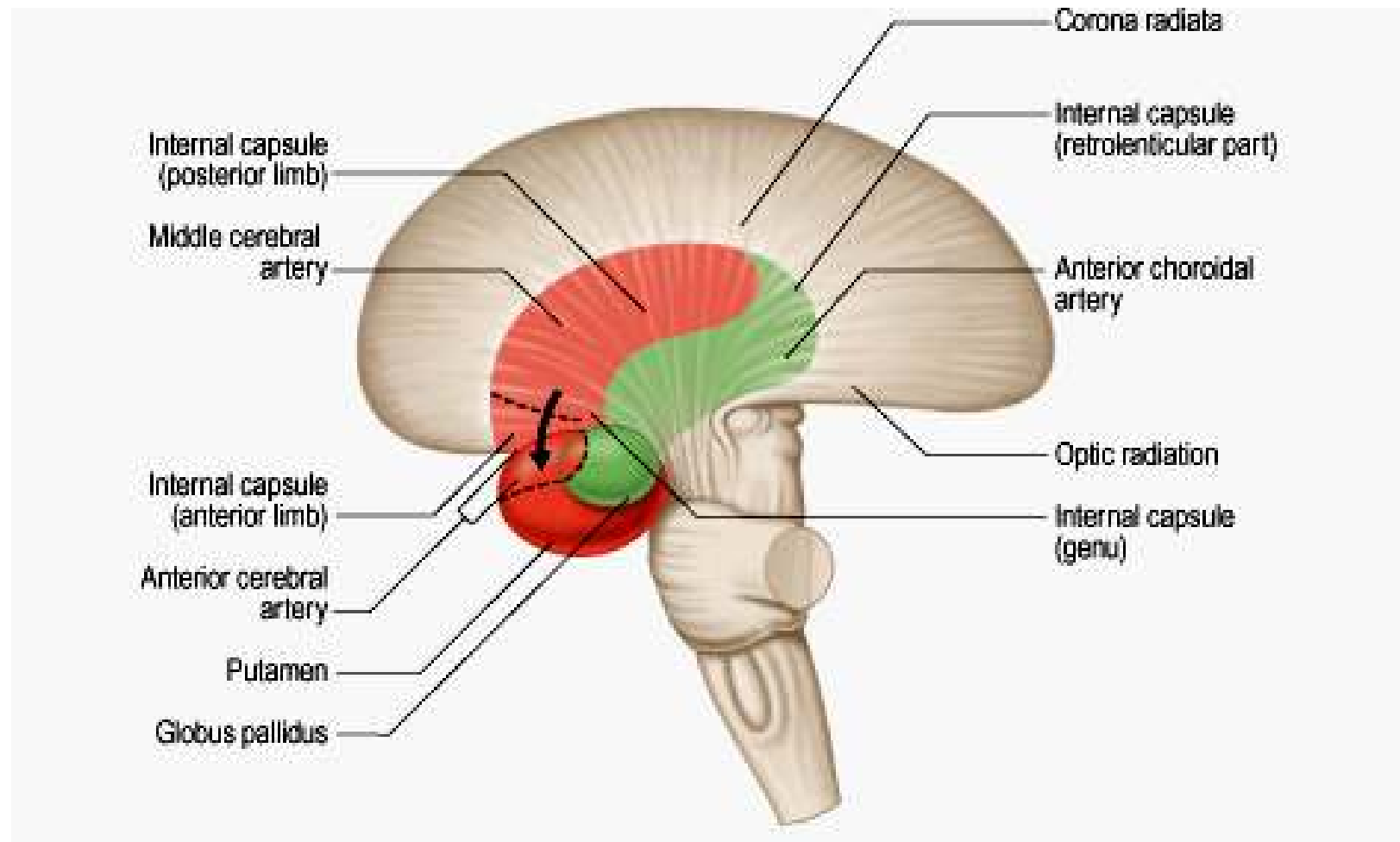
B, The medial surface of the left cerebral hemisphere, showing the areas supplied by the cerebral arteries. In these figures the area supplied by the anterior cerebral artery is coloured blue, that by the middle cerebral artery pink and that by the posterior cerebral artery is yellow.

Anterior Cerebral Artery

important functional areas supplied by cortical brs.

LOBE	AREA
FRONTAL LOBE	Motor – lower limb and perineum - pericentral lobule
PARIETAL LOBE	Sensory – lower limb and perineum - paracentral lobule

Anterior Cerebral Artery: Central brs.



Territory supplied by branches of the anterior and middle cerebral arteries is shown in red. Territory supplied by the anterior choroidal artery is shown in green.

Anterior Cerebral Artery: cortical brs.

- **Medial striate artery** *recurrent artery of Heubner* (*pron. 'Hoibner'*):
 - Arises close to the anterior communicating artery
 - Supplies:
 1. Ant. Part of head Caudate & Adjacent part of internal capsule
 2. Putamen
 3. Septal nuclei
-

Anterior Cerebral Artery: Central brs.



Anterior cerebral artery , anterior communicating artery & ICA



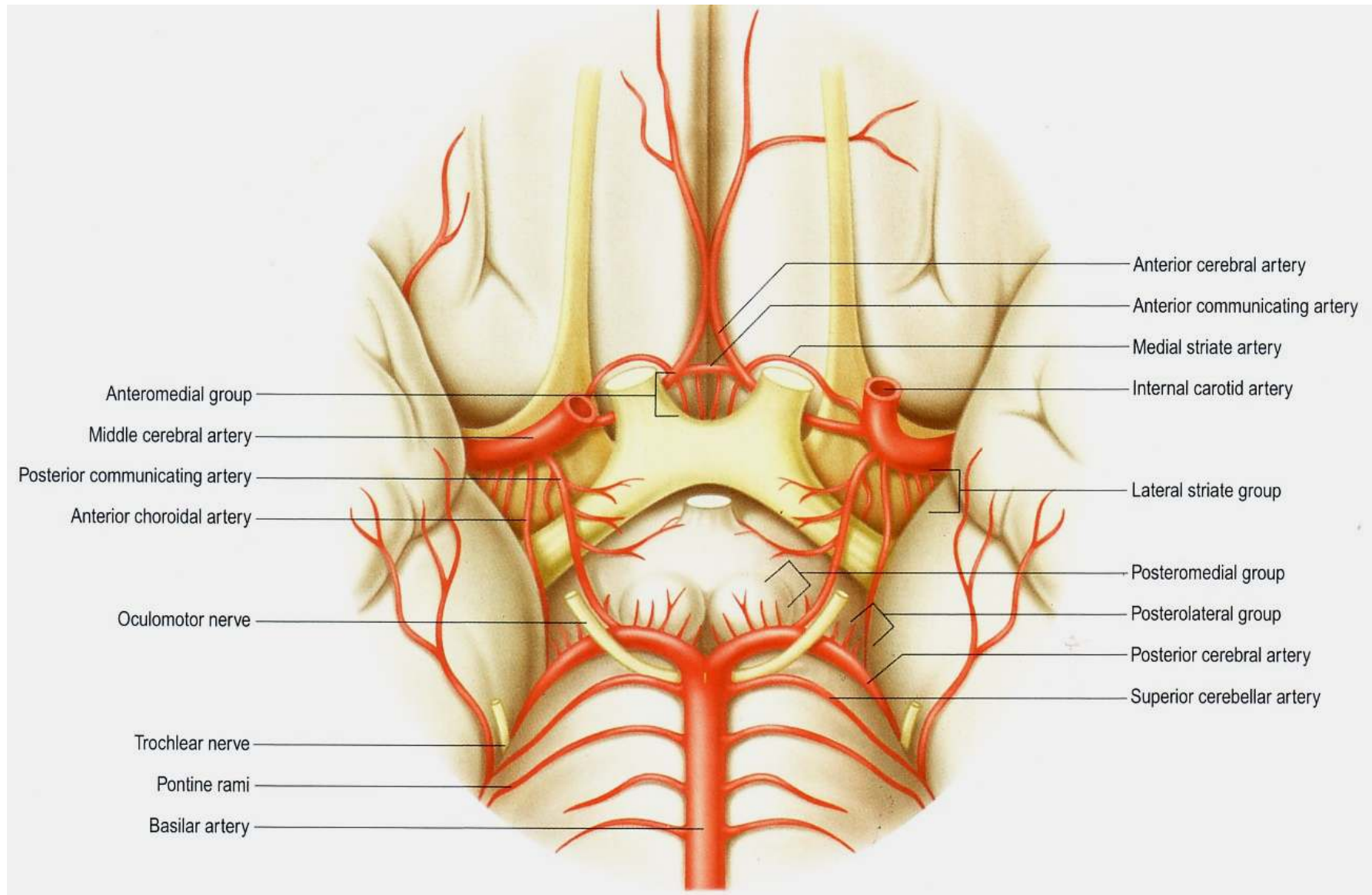
Anteromedial group of central brs



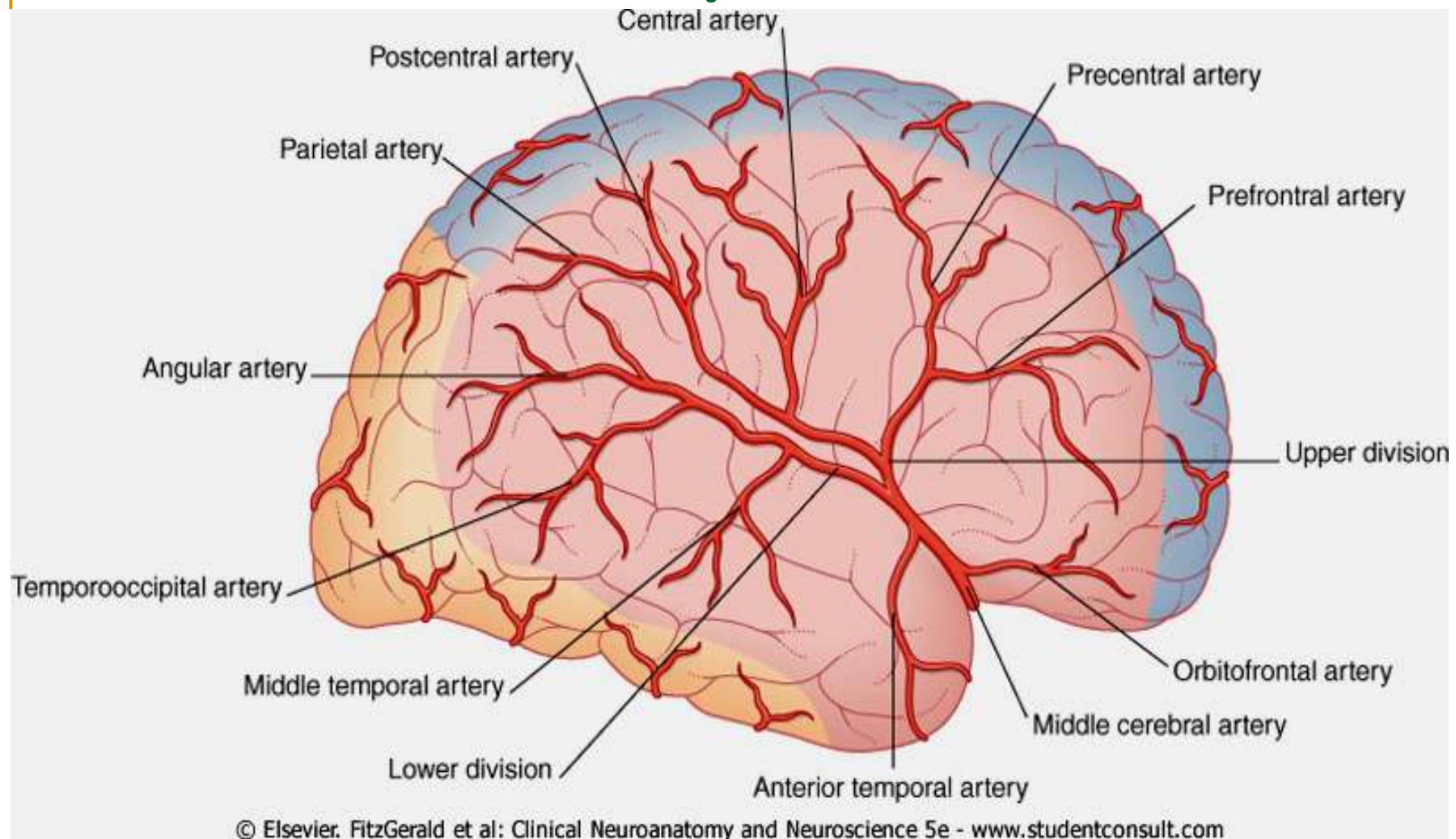
Anteromedial group of central brs :
distribute to the anterior of the hypothalamus

Middle Cerebral Artery

Anterior Cerebral artery: Course

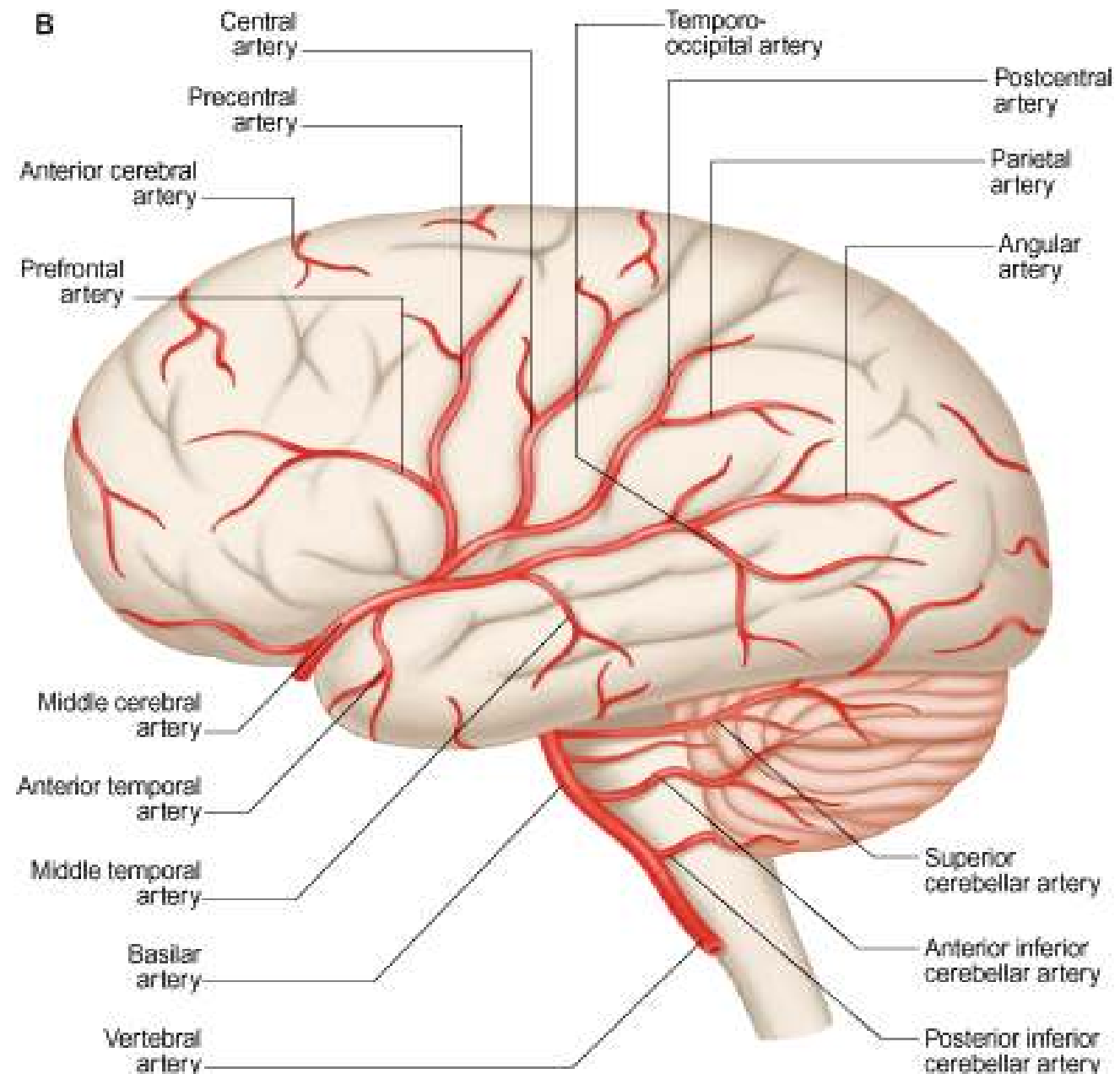


Middle Cerebral Artery: Cortical brs.



Lateral view of right cerebral hemisphere, showing the cortical branches and territories of the three cerebral arteries.

Middle Cerebral Artery: Course & Branches

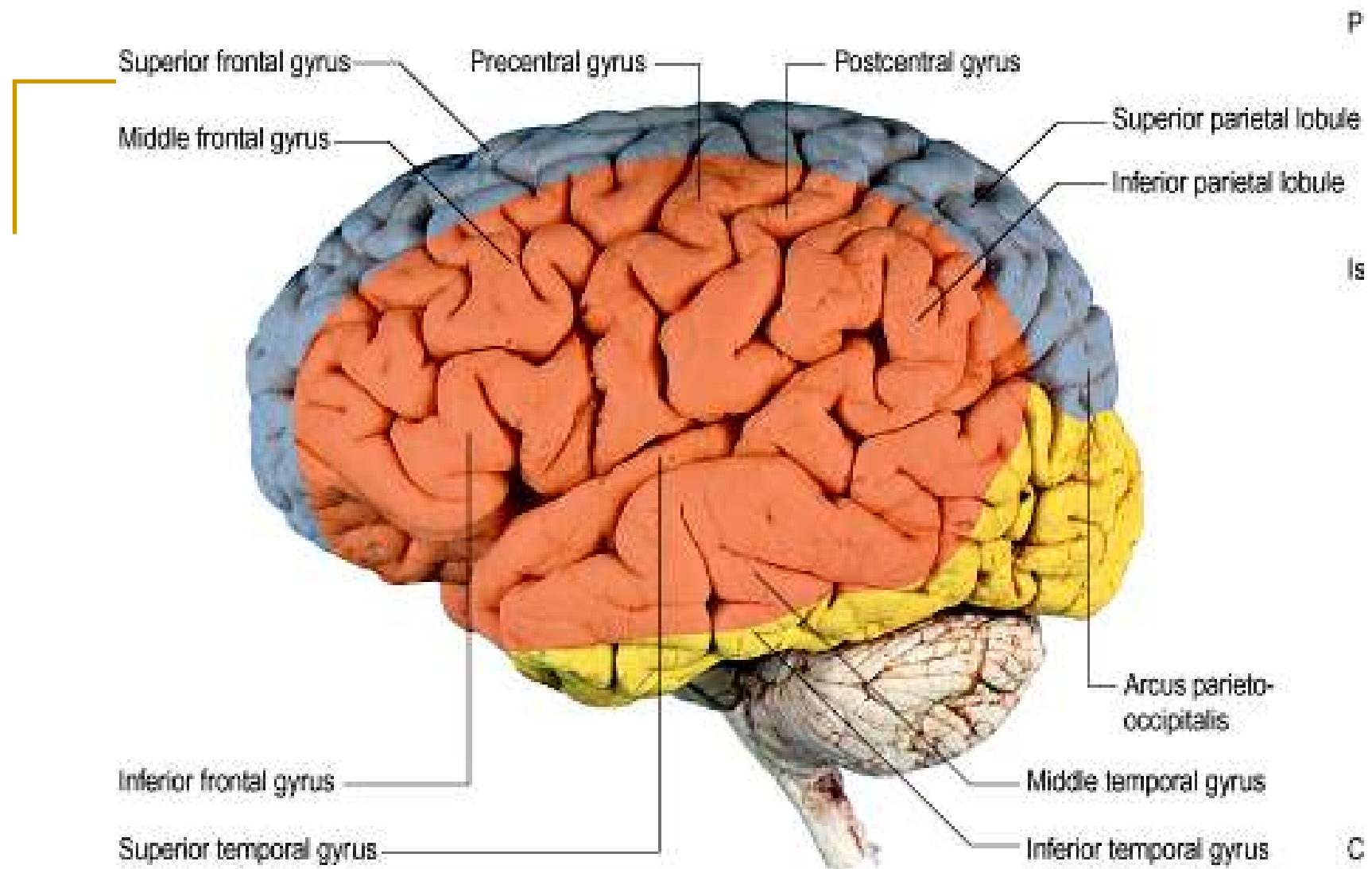


Major arteries of the brain. B, lateral aspect.

Cortical branches of the middle cerebral artery

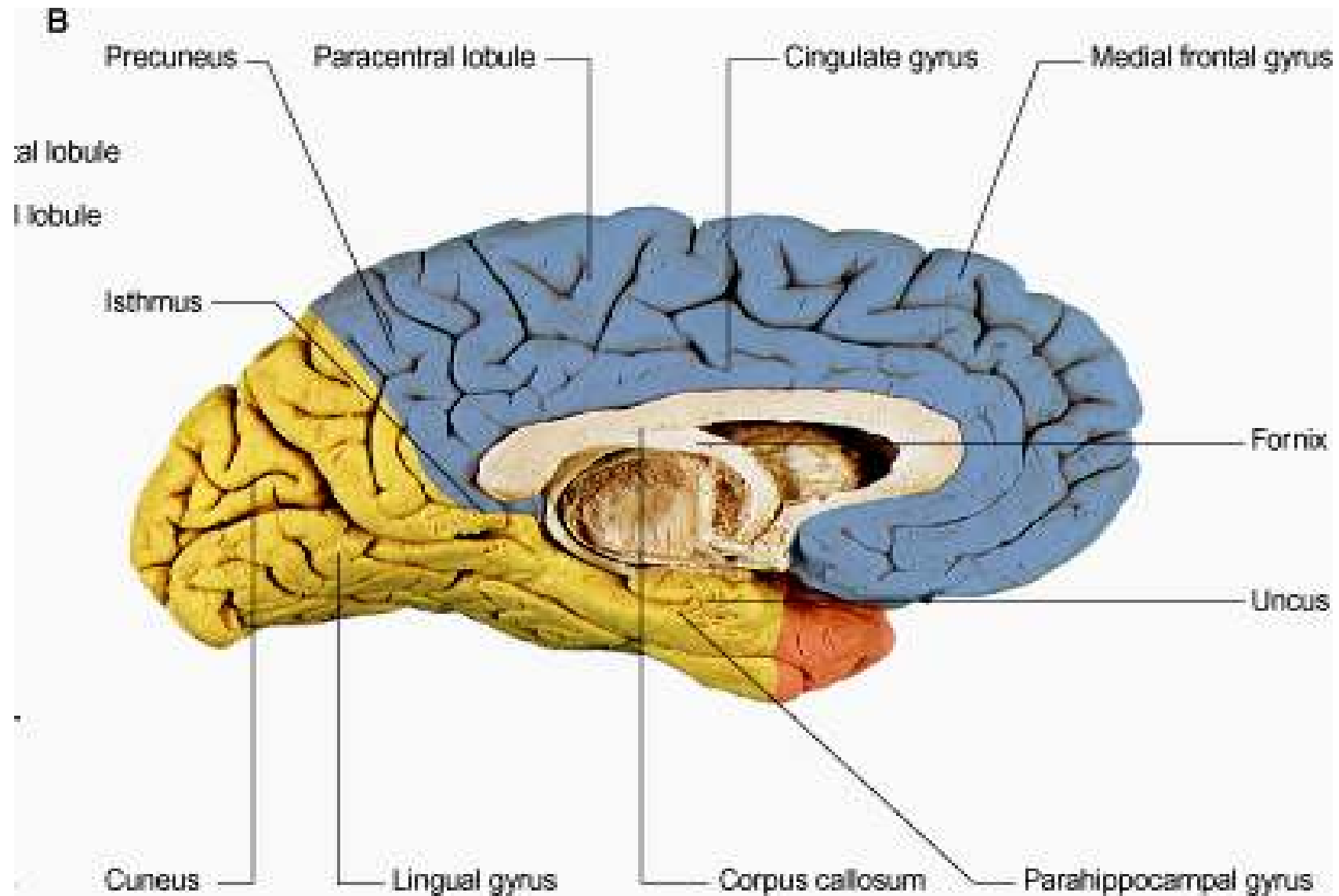
Origin	(Branch(es	Territory
Stem	Frontobasal	Orbital surface of frontal lobe
	Anterior temporal	Anterior temporal cortex
Upper division	Prefrontal Precentral	Prefrontal cortex Premotor areas
	Central	Pre- and postcentral gyri
	Postcentral	Postcentral and anterior parietal cortex
	Parietal	Posterior parietal cortex
Lower division	Middle temporal Temporooccipital	Midtemporal cortex Temporal and occipital cortex
	Angular	Angular and neighboring gyri

Middle Cerebral Artery: Cortical Distribution



The lateral surface of the left cerebral hemisphere, showing the areas supplied by the cerebral arteries.. In these figures the area supplied by the anterior cerebral artery is coloured blue, that by the middle cerebral artery pink and that by the posterior cerebral artery is yellow.

Middle Cerebral Artery: Cortical Distribution



B, The medial surface of the left cerebral hemisphere, showing the areas supplied by the cerebral arteries. In these figures the area supplied by the anterior cerebral artery is coloured blue, that by the middle cerebral artery pink and that by the posterior cerebral artery is yellow.

Middle Cerebral Artery

Important functional areas supplied by the Cortical brs

LOBE	AREA
FRONTAL	Motor – except for paracentral lobule
	Motor speech – esp left side
PARIETAL	Sensory – except for paracentral lobule
	Sensory speech
TEMPORAL	Auditory

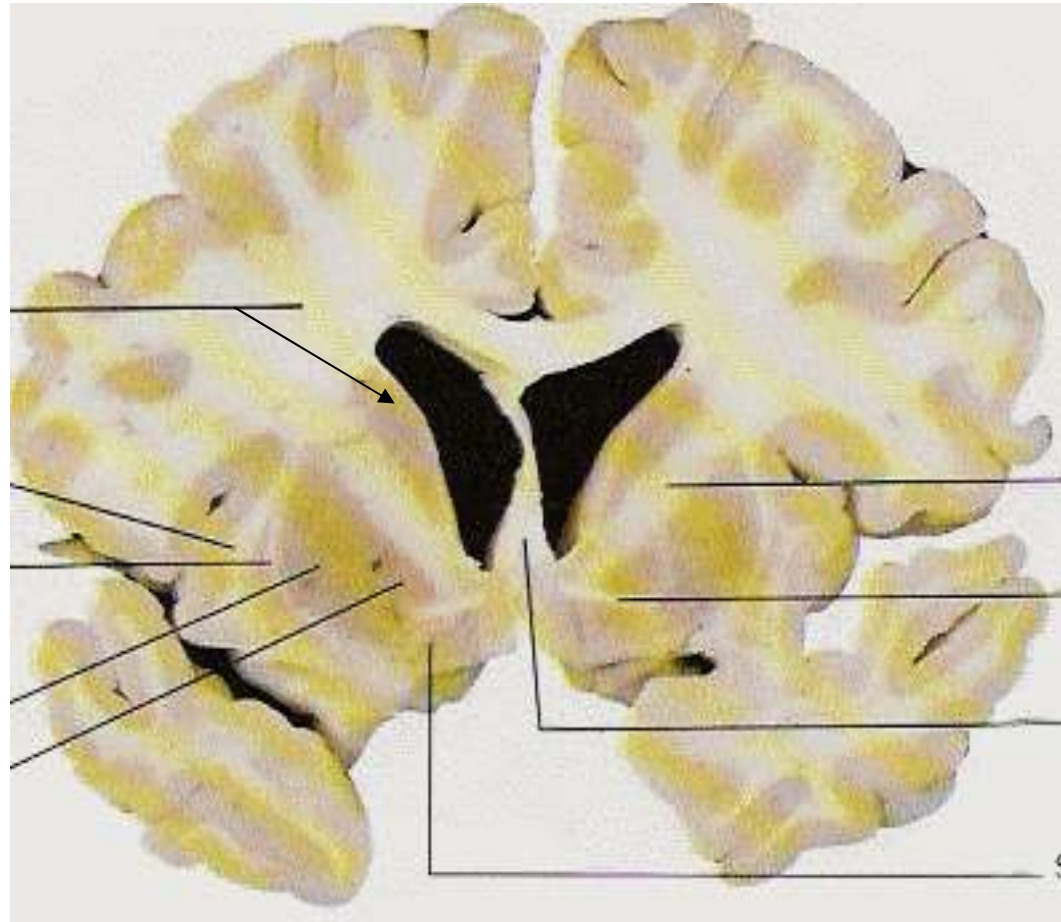
Middle cerebral artery & anterior choroidal artery

1- Medial Striate arteries Supply:

Lentiform nucleus

Caudate nucleus

Internal capsule (ANT
& POST)



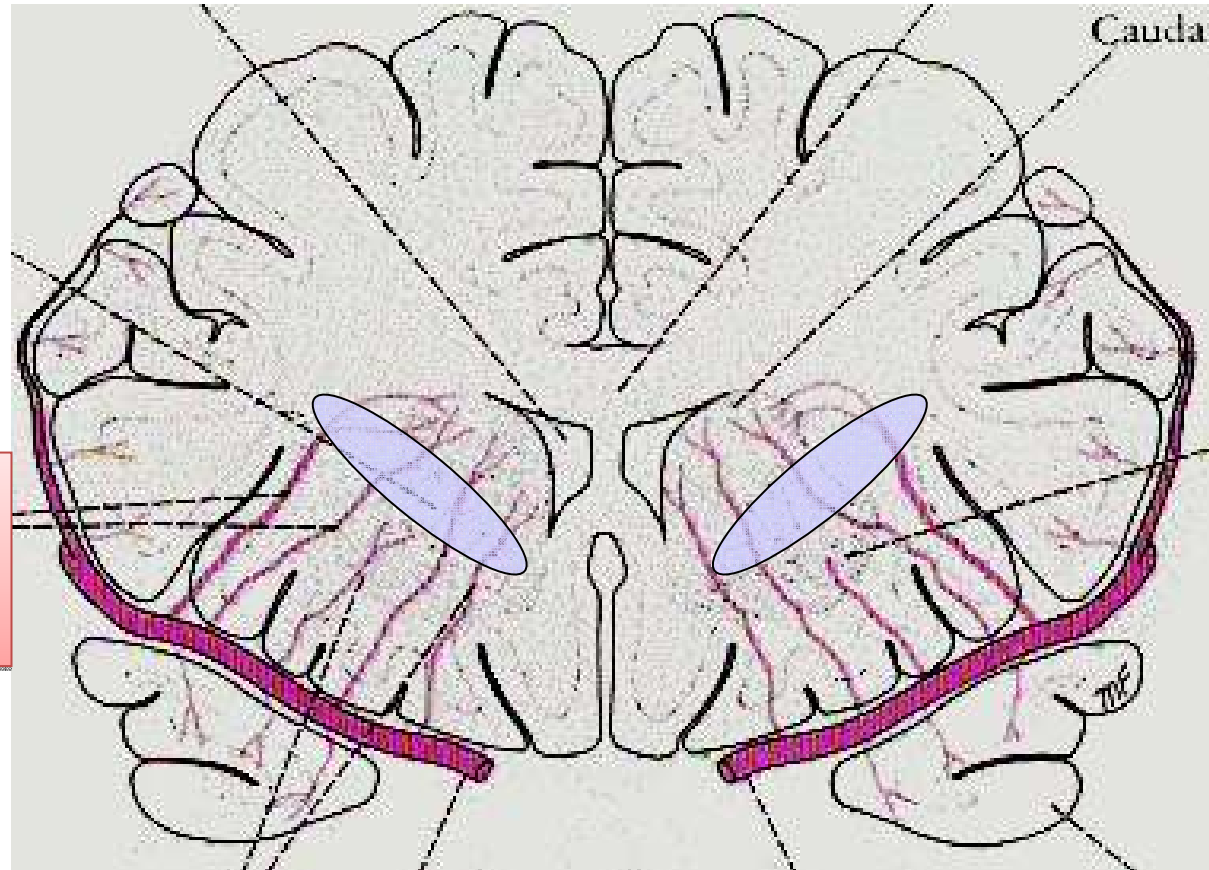
Middle Cerebral Artery: Central brs

2- Lateral striate arteries:

- Supply the **Corpus striatum, internal capsule, and Anterior of thalamus.**
 - One of this group is specially large & more susceptible to hemorrhage & called artery of cerebral hemorrhage (Charcot's Artery)
 - Occlusion of one of the lateral striate arteries is the chief cause of classic *stroke* , where damage to the pyramidal tract in the posterior limb of the internal capsule causes *hemiplegia* ,a term denoting paralysis of the contralateral arm, leg, and lower part of face .
-

Middle Cerebral Artery: Central brs

Lateral
striate
arteries



Left middle
cerebral artery

Right middle
cerebral artery

Comparison between cerebral arteries

	Anterior Cerebral	Middle Cerebral	Posterior Cerebral
Begins	From int. carotid a.	From int. carotid a.	From basilar artery
Sulcus related	Callosal	Stem of lateral s.	Calcarine
Branches	1- Cortical 2- Central 3- Callosal	1- Cortical 2- Central	1- Cortical 2- Central 3- Callosal 4- Choroidal

Choroidal Arteries

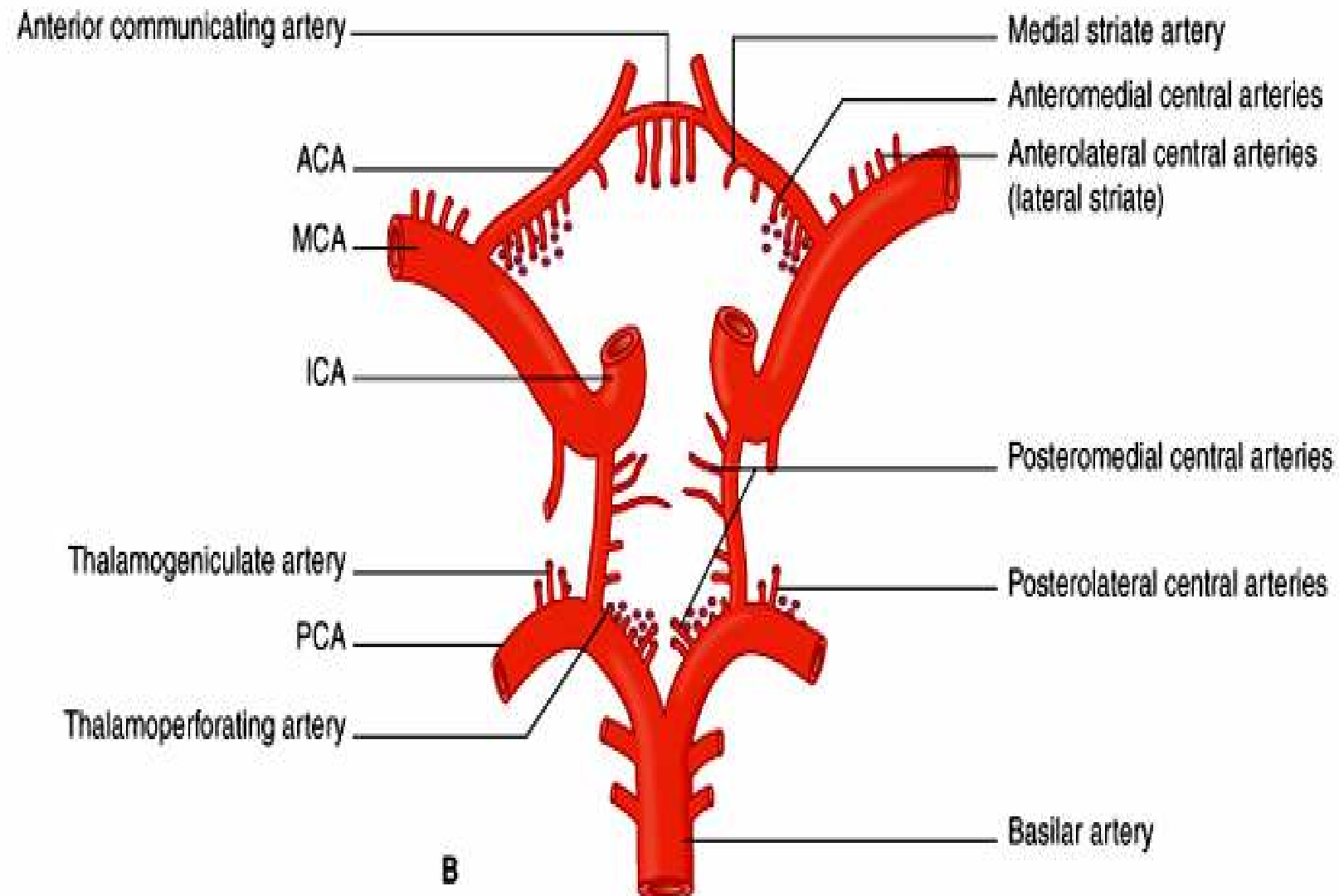
- **The Anterior Choroidal A.:** from the Internal Carotid A.
 - **The Posterior Choroidal A.:** from the posterior cerebral artery to supply the choroid plexus of the lateral ventricle .
 - **The Choroidal Branch of posterior inferior Cerebellar A.**
-

CIRCLE OF WILLIS

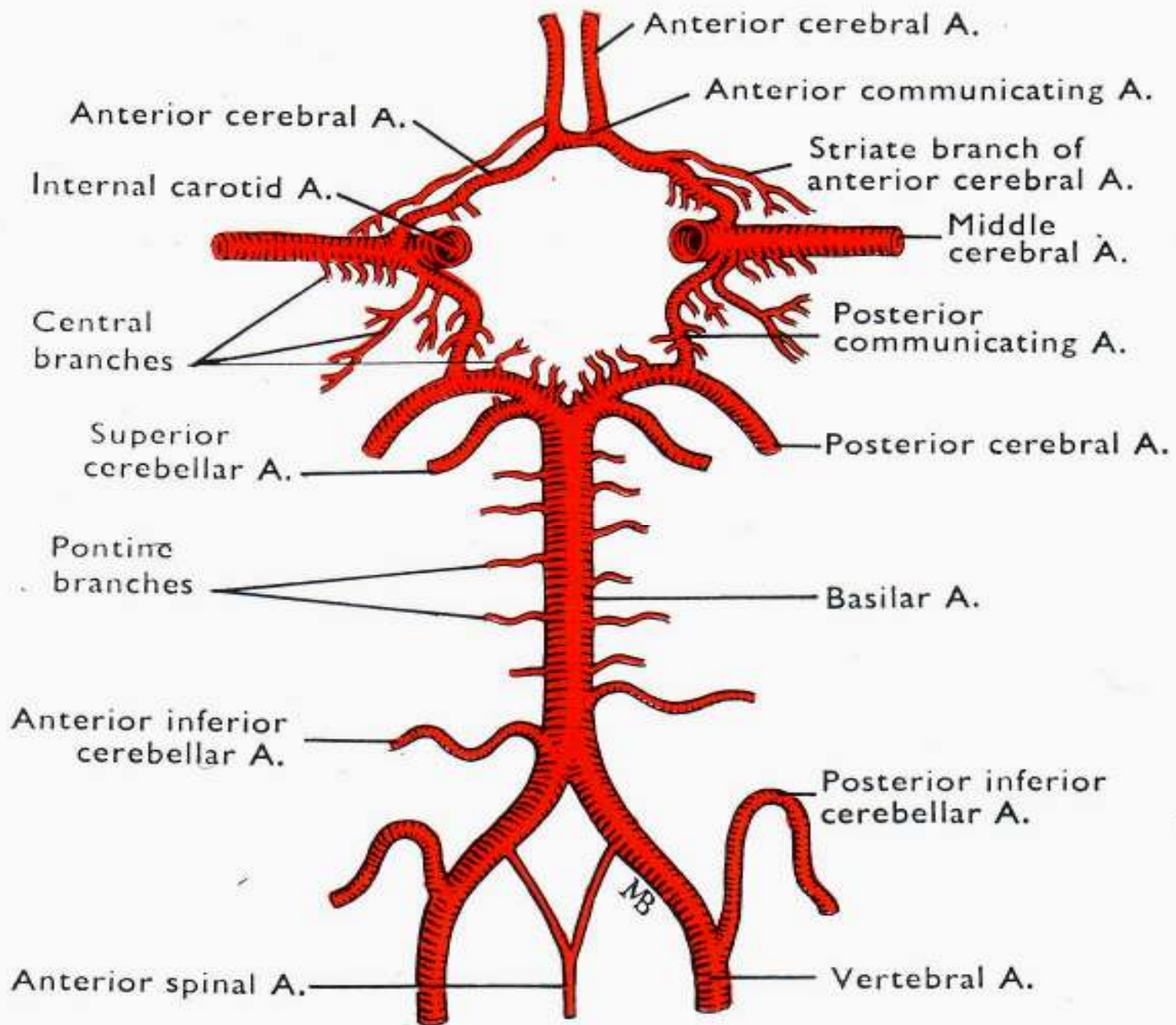
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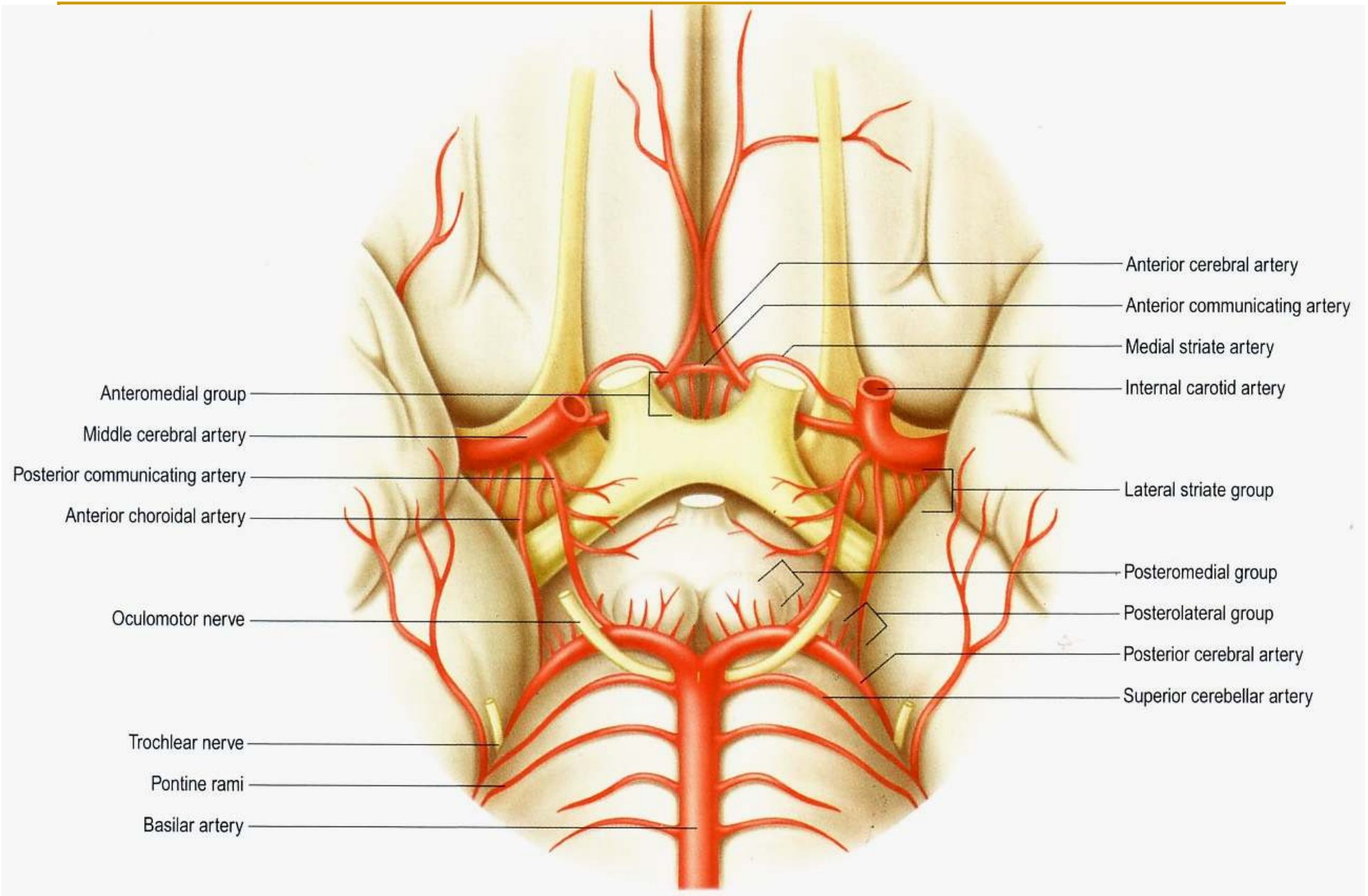
Arterial Circle Of Willis

- **Site:** at the base of the brain around interpeduncular fossa.
 - **Function:** Important anastomosis between the 2 internal carotid arteries in front & Vertebro-basilar system behind.
 - **Arteries forming it:**
 - ❑ Rt. & Lt. internal carotid artery.
 - ❑ Rt. & Lt. anterior cerebral arteries.
 - ❑ Rt. & Lt. posterior cerebral arteries.
 - ❑ Rt. & Lt. posterior communicating arteries.
 - ❑ Anterior communicating artery.
-



The arteries comprising the circle of Willis. The four groups of central branches are shown; the thalamoperforating artery belongs to the posteromedial group, and the thalamogeniculate artery belongs to the posterolateral group. ACA, MCA, PCA, anterior, middle, posterior cerebral arteries; ICA, internal carotid artery.





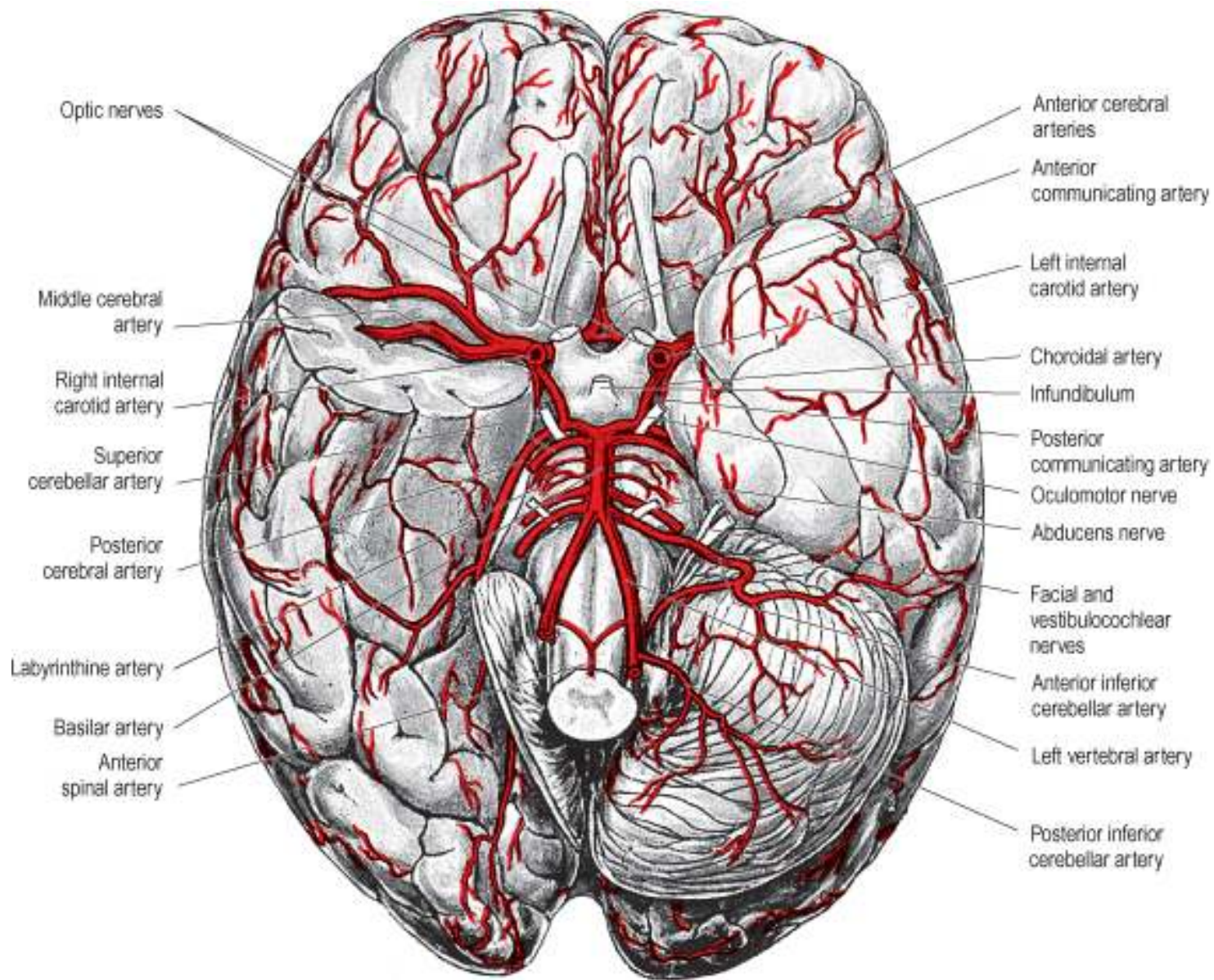
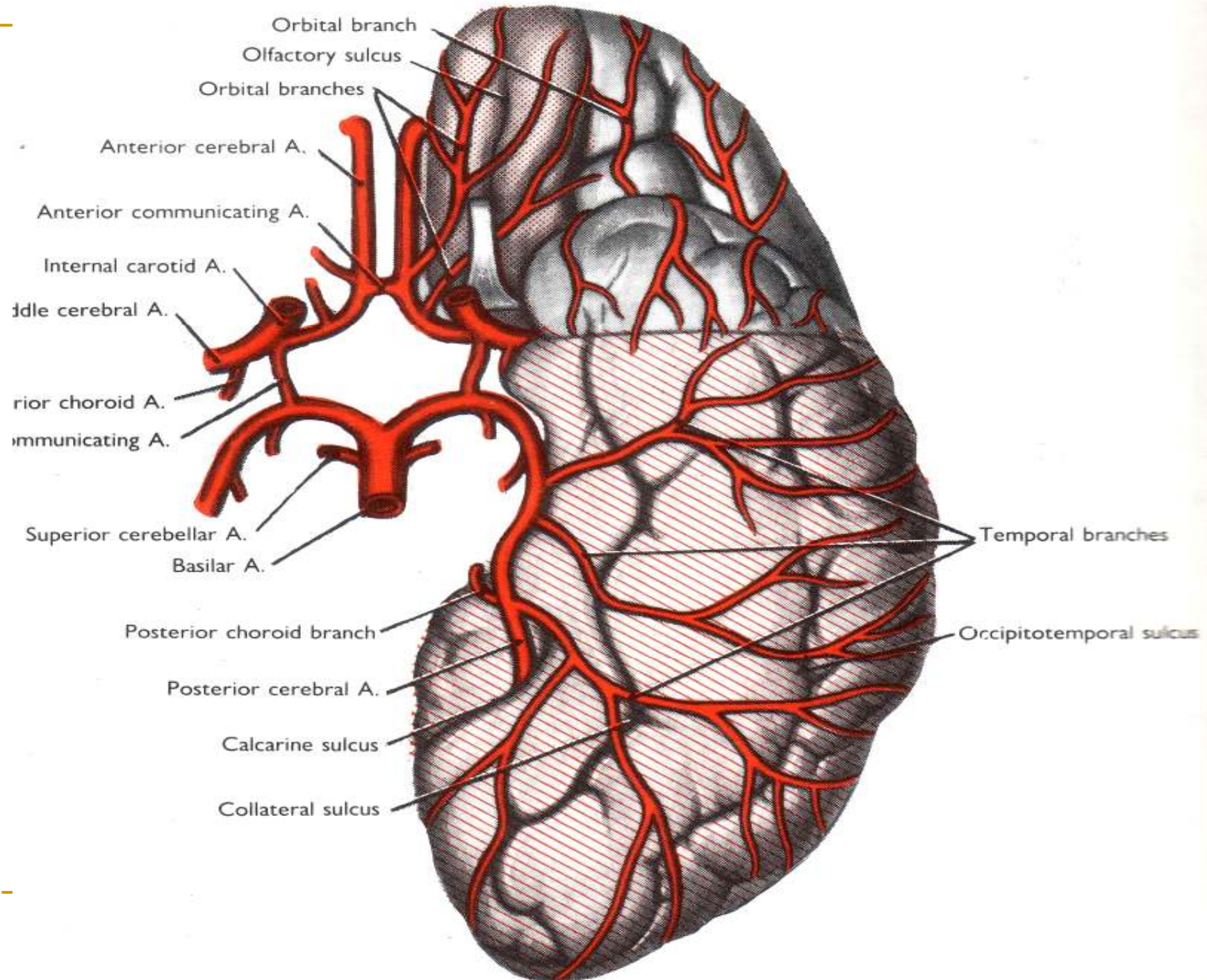
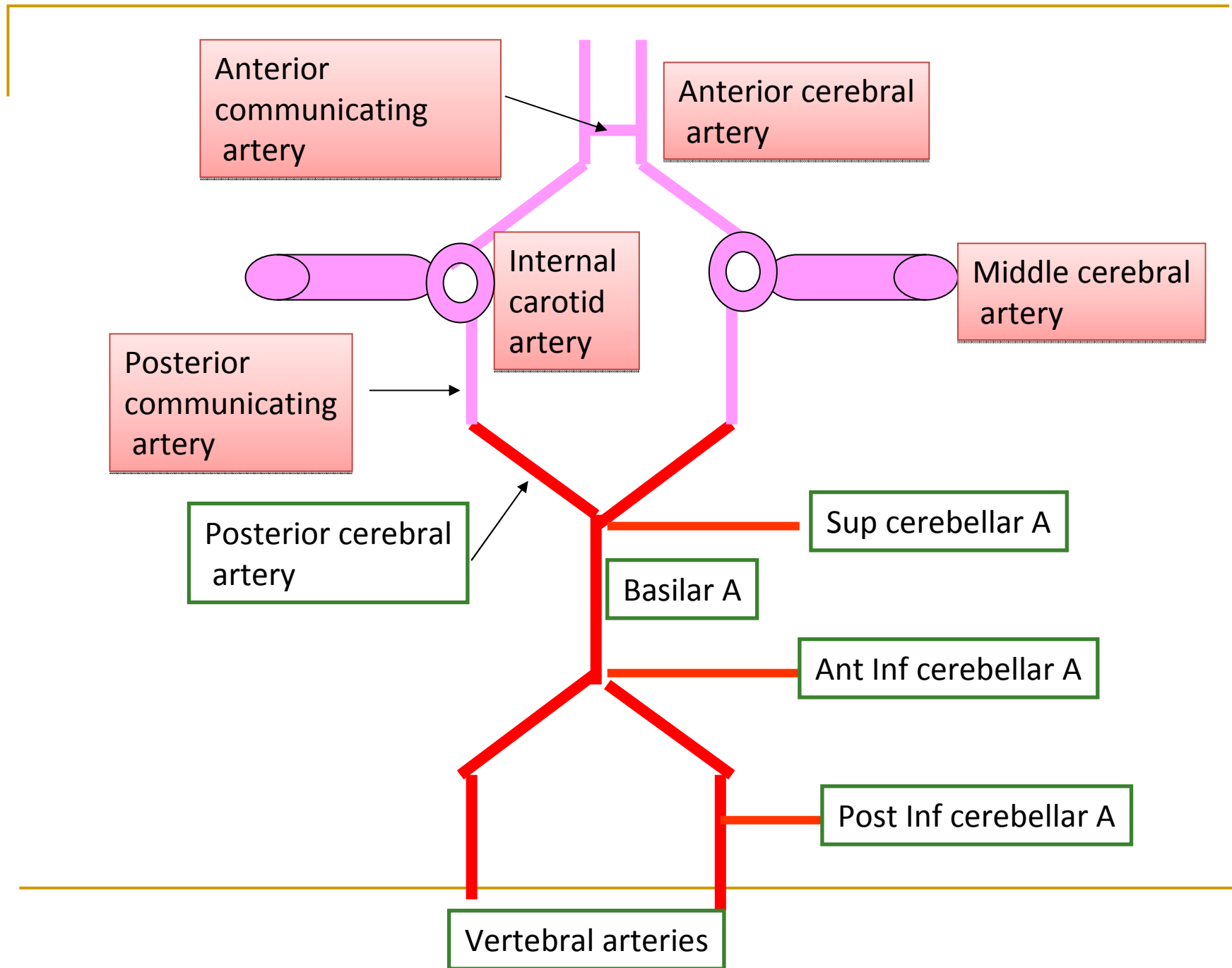


Figure 17.4 The arteries on the base of the brain. The anterior part of the right temporal lobe has been removed to display the initial course of the middle cerebral artery within the lateral fissure.





Blood Supply of The Cerebrum

CIRCLE OF WILLIS

■ Rt & Lt Vertebro-basilar terminal branch:

- Posterior cerebral artery

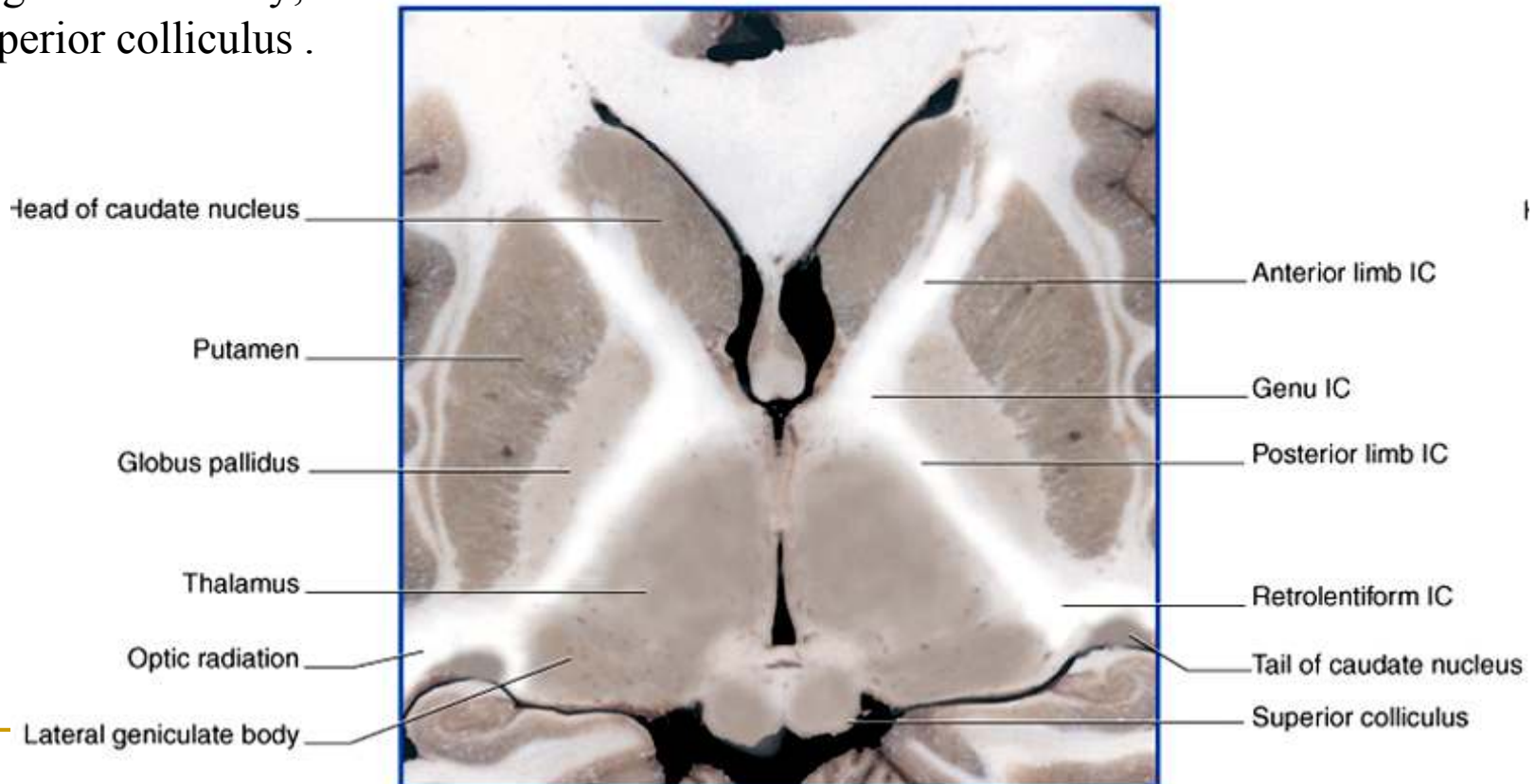
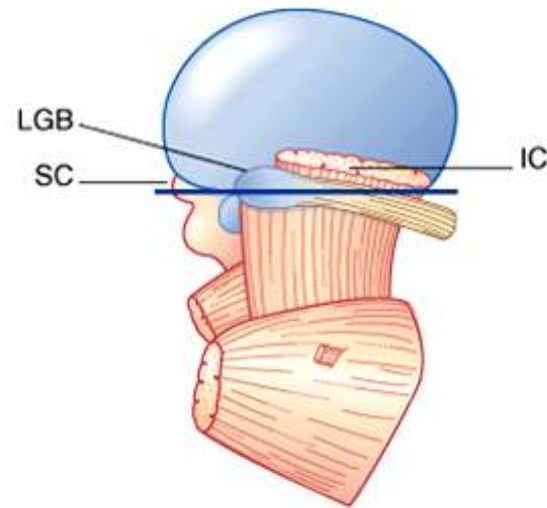
■ Rt & Lt Internal Carotid & their branches:

- Rt& Lt Middle cerebral As.
- Rt& Lt Anterior cerebral As.
- Anterior communicating A.
- Rt&Lt Posterior communicating As.

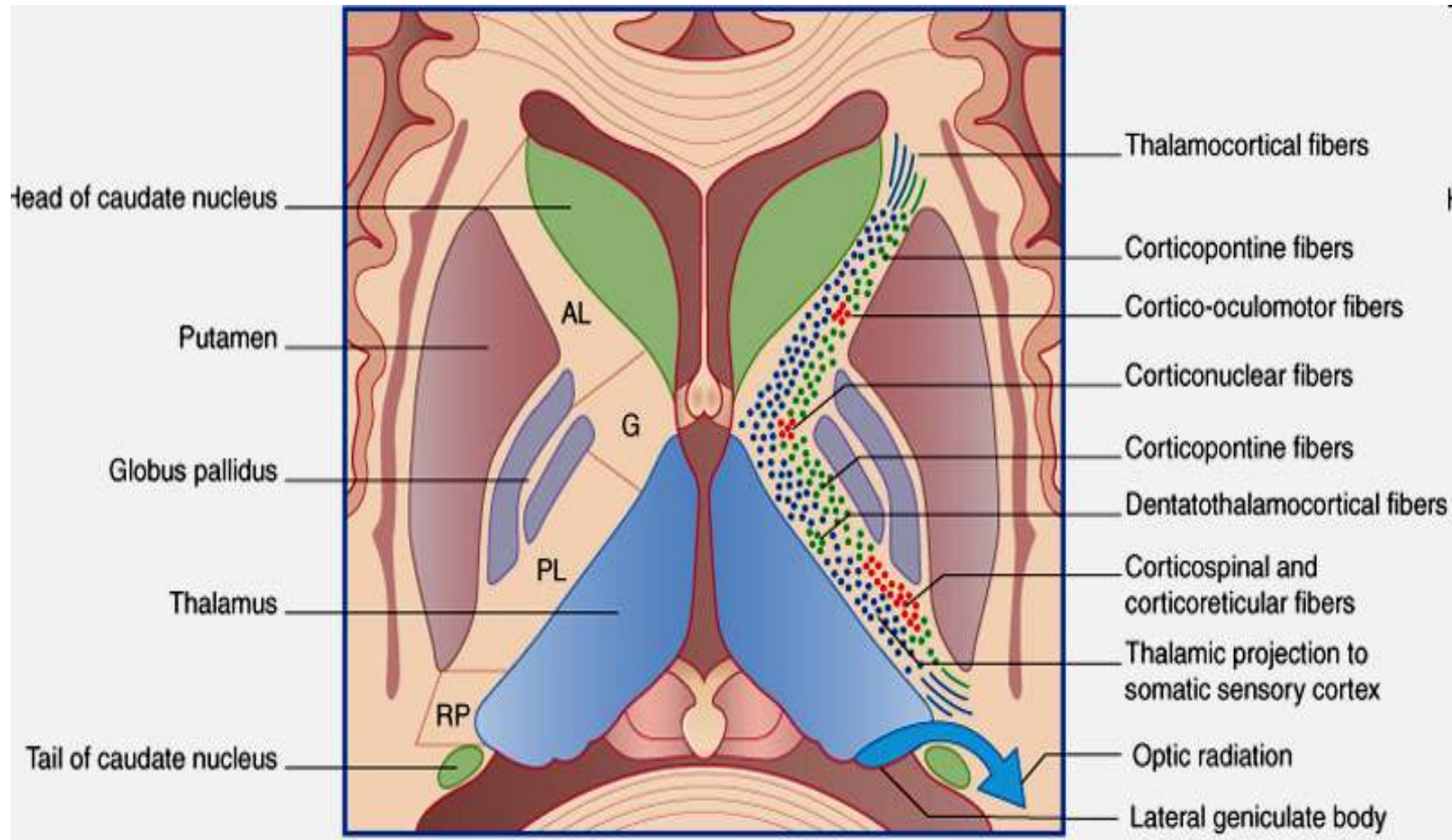
Summary Blood Supply of Specific areas of the Brain

By
Dr. Noura El Tahawy

Horizontal section of the internal capsule at the level indicated, depicting its boundaries and parts (left) and stroke-relevant motor contents (right). IC internal capsule; LGB, lateral geniculate body; SC, superior colliculus .



Anatomy of the Internal Capsule

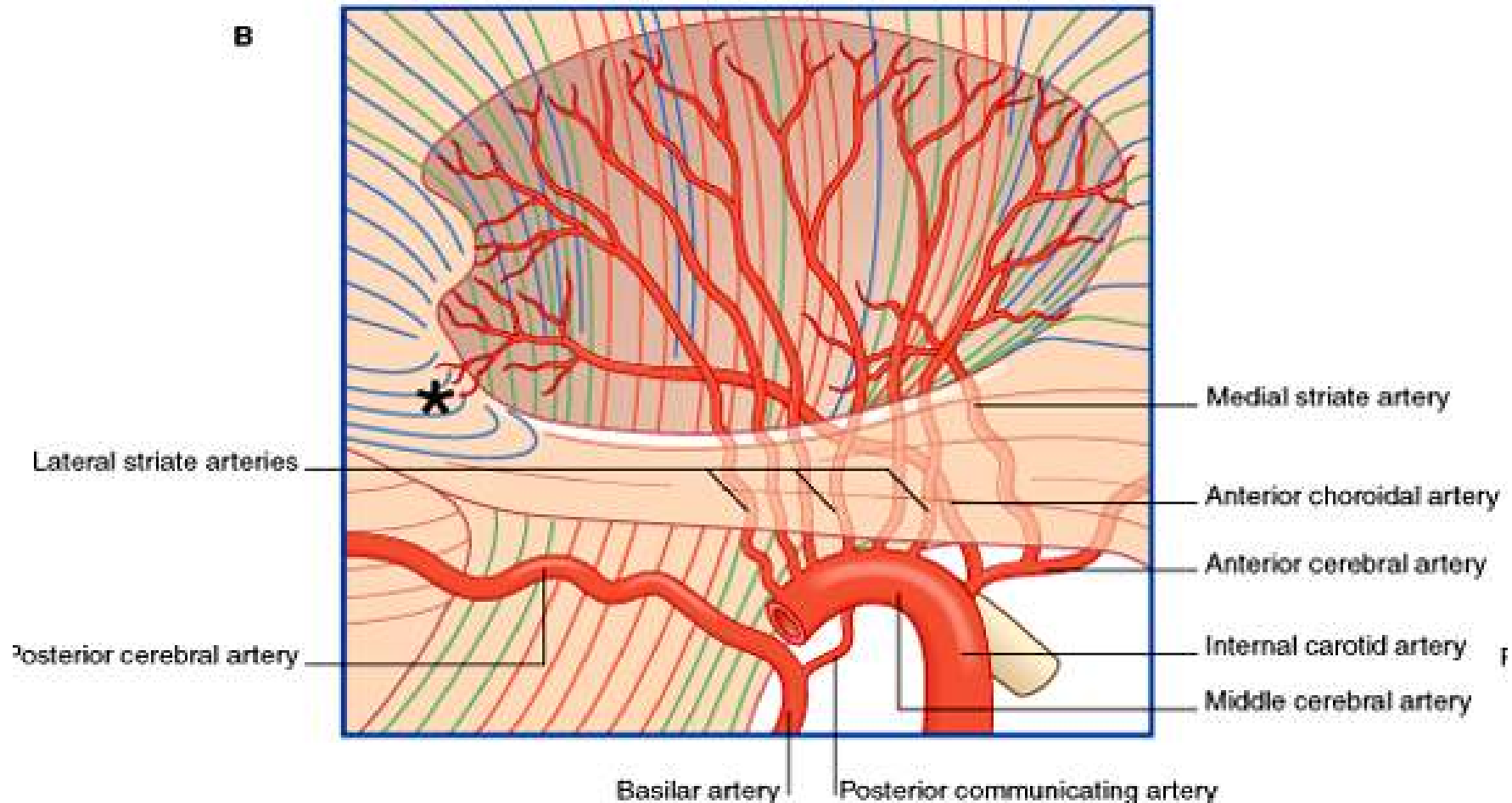


Horizontal section of the internal capsule, depicting its parts) *left* (and contents) *right* .(AL, anterior limb; G, genu; PL, posterior limb; RP, retrolentiform part .

Arterial Supply of the Internal capsule

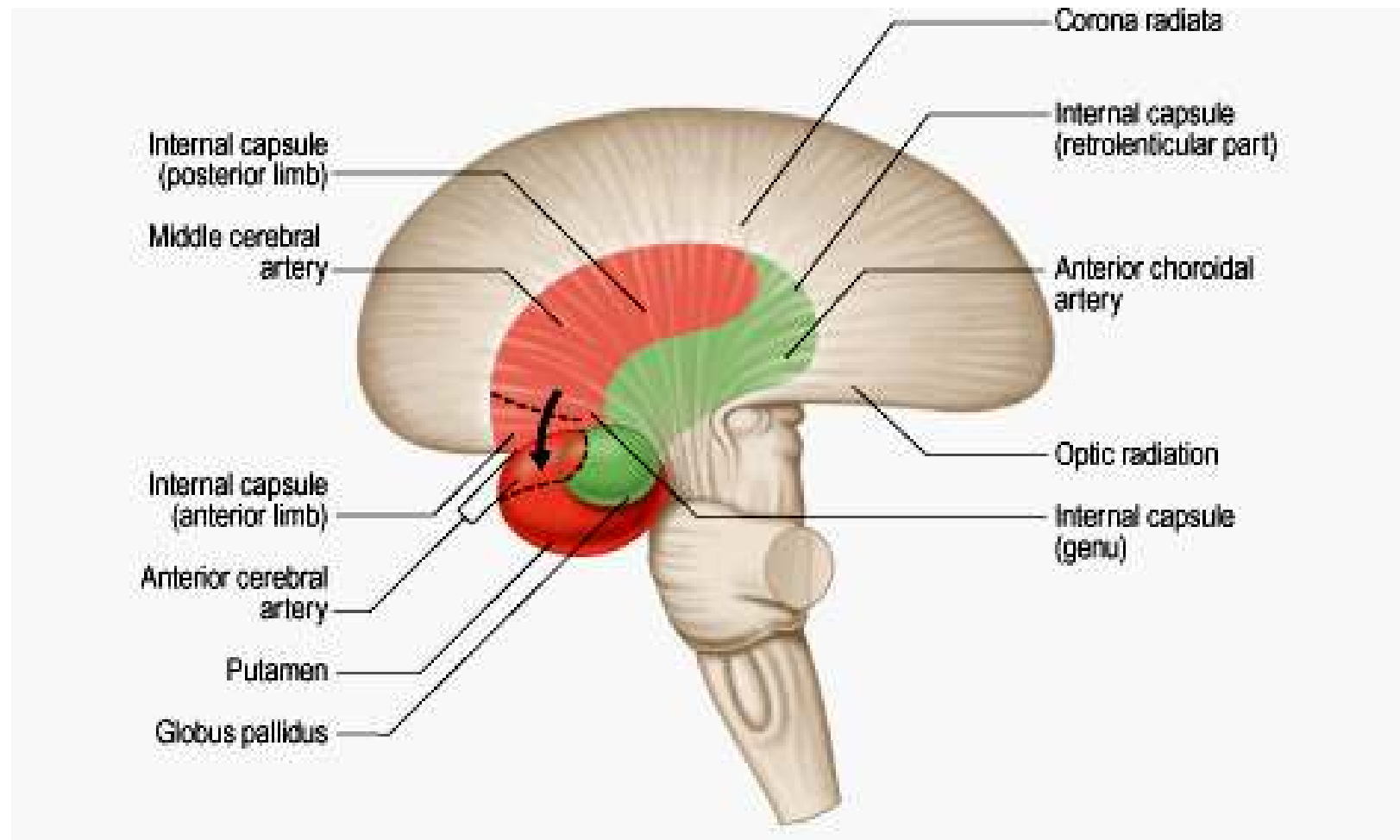
- The three sources of supply are:
- **Anterior choroidal**, a direct branch of the internal carotid. The anterior choroidal branch of the ICA supplies the lower part of the posterior limb and the retrolentiform part of the internal capsule, and the inferolateral part of the lateral geniculate body. Some of its branches (not shown) supply a variable amount of the temporal lobe of the brain and the choroid plexus of the inferior horn of the lateral ventricle;
- **Medial striate**, branch of the anterior cerebral artery (recurrent artery of Heubner) supplies the lower part of the anterior limb and genu of the internal capsule.
- **Lateral striate (lenticulostriate)** branches of the middle cerebral artery. The lateral striate arteries penetrate the lentiform nucleus and give multiple branches to the anterior limb, genu, and posterior limb of the internal capsule

Arterial Supply of the Internal capsule



The medial striate branch of the anterior cerebral artery is the recurrent artery of Heubner.
Only two of the six lateral striate branches of the middle cerebral artery shown are labeled.
The asterisk indicates arterial supply from the anterior choroidal artery to the inferolateral part of the lateral geniculate body .

Arterial Supply of the Internal capsule



Territory supplied by branches of the anterior and middle cerebral arteries is shown in red. Territory supplied by the anterior choroidal artery is shown in green.

Arteries to specific brain areas

Corpus striatum	Medial & lateral striate brs	Anterior & Middle cerebral arteries
Internal capsule		
Thalamus	P Com. A, basilar, PCA	
Midbrain	PCA, sup Cerebellar A, basilar	
Pons	Pontine brs. of Basilar, Ant. Inf. cerebellar, sup. Cerebellar A.	
Medulla oblongata	Vertebral, Posterior inf. Cerebellar, Anterior Inferior Cerebellar A, basilar	
Cerebellum	Sup. Cerebellar, AICA, PICA	

Venous Drainage of the Brain

VENOUS DRAINAGE of THE BRAIN

■ EXTERNAL

- Superior cerebral
- Superficial middle cerebral
- Deep middle cerebral

■ INTERNAL

- Thalamo striate
- choroidal

● SPECIFIC

- Midbrain
 - Pons
 - Medulla oblongata
 - cerebellum
-

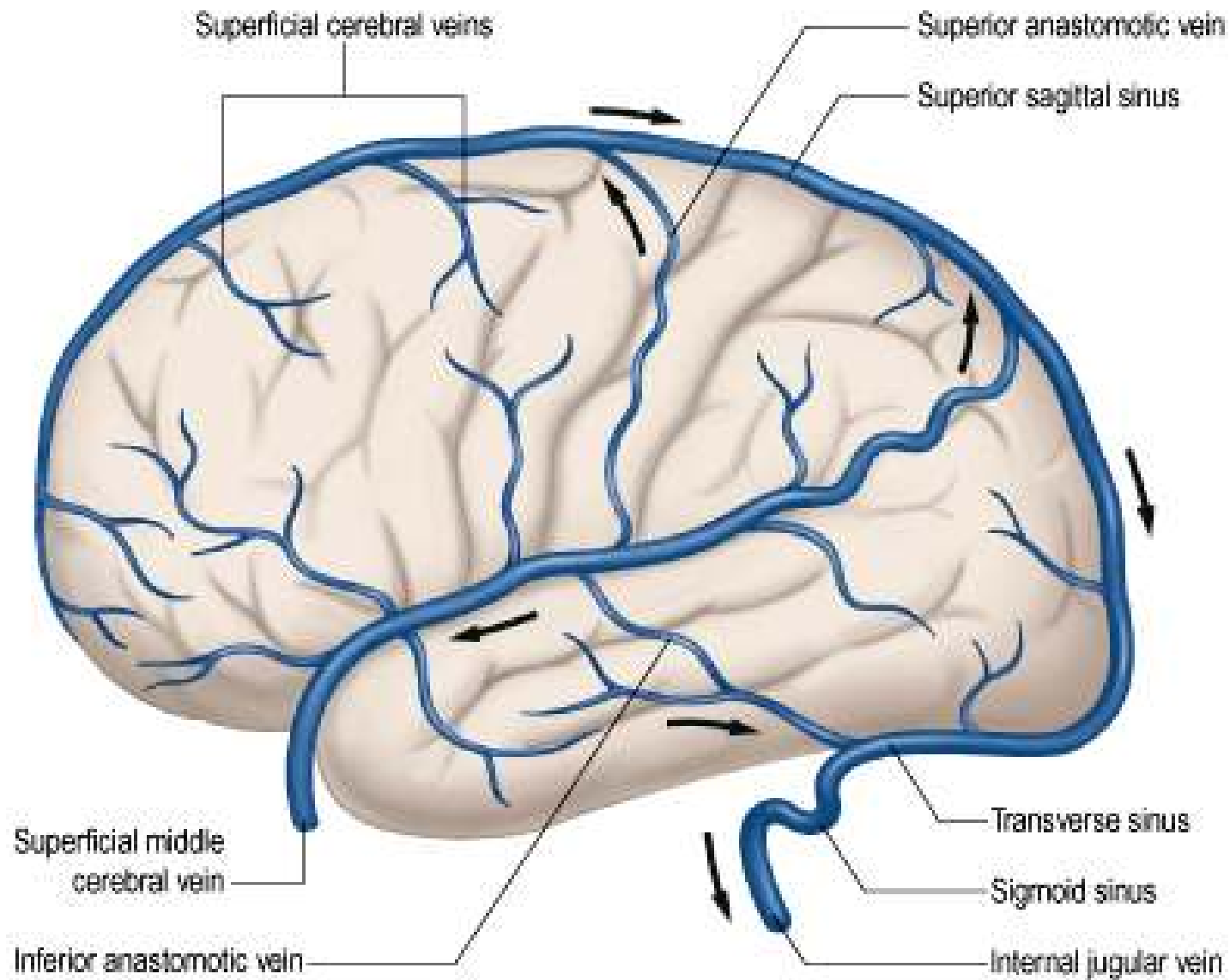
External Cerebral Veins

VEIN	AREA	DRAINS INTO
Superior cerebral veins	Lateral surface of cerebral hemisphere	Superior Sagittal sinus
Superficial middle cerebral		Cavernous sinus
Inferior cerebral veins		Superficial middle cerebral V
Sup. Anastomotic V		Communicates between the superficial middle cerebral V & Superior Sagittal sinus
Inf. anastomotic V		Communicates between superficial middle cerebral V & transverse sinus

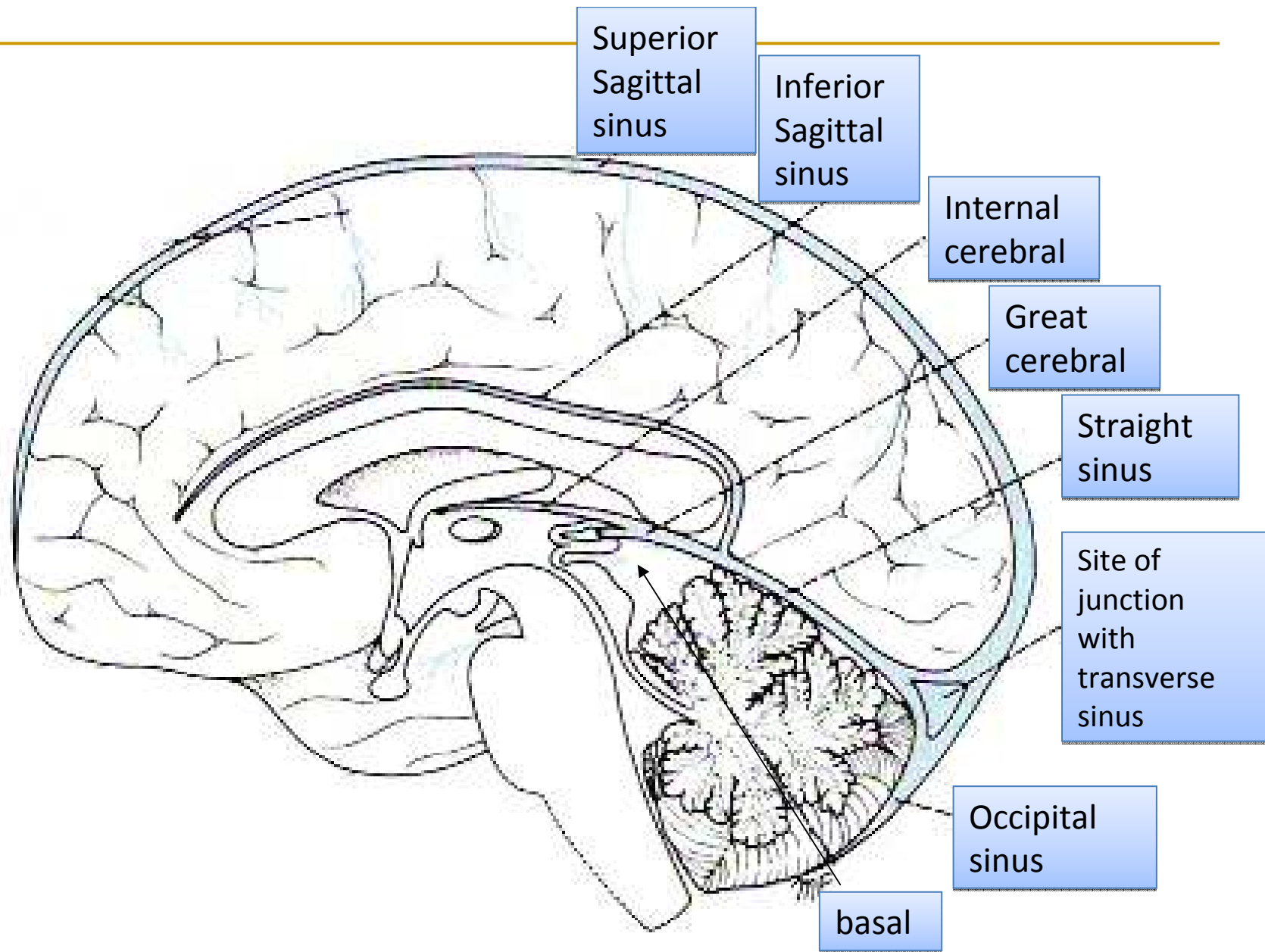
External Cerebral Veins

VEIN	AREA	DRAINS INTO
Deep middle cerebral	Insula	Joined by ant. cerebral & striate veins to form basal vein
<ul style="list-style-type: none"> • Anterior cerebral • Deep middle cerebral • Striate veins 		The three veins unite to form the Basal vein
Basal vein	Inferior Surface	Rt. & Lt basal veins drain into the great cerebral vein
Great Cerebral vein	Behind splenium of CC & formed by the union of the 2 internal cerebral veins	Unite with the inferior sagittal sinus to form straight sinus

External Cerebral Veins



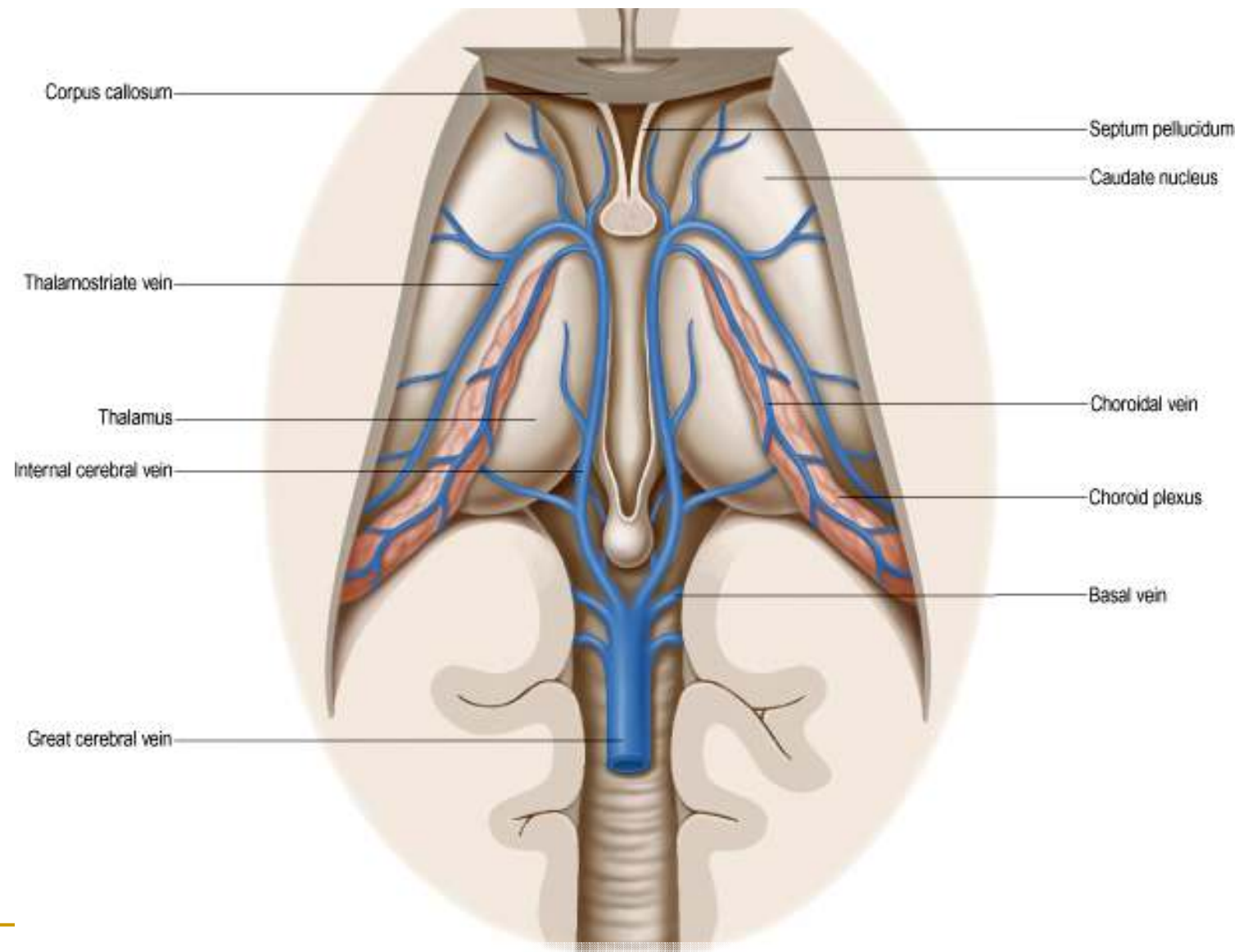
The external (superficial) cerebral veins of the left hemisphere and their relationship to the dural venous sinuses.



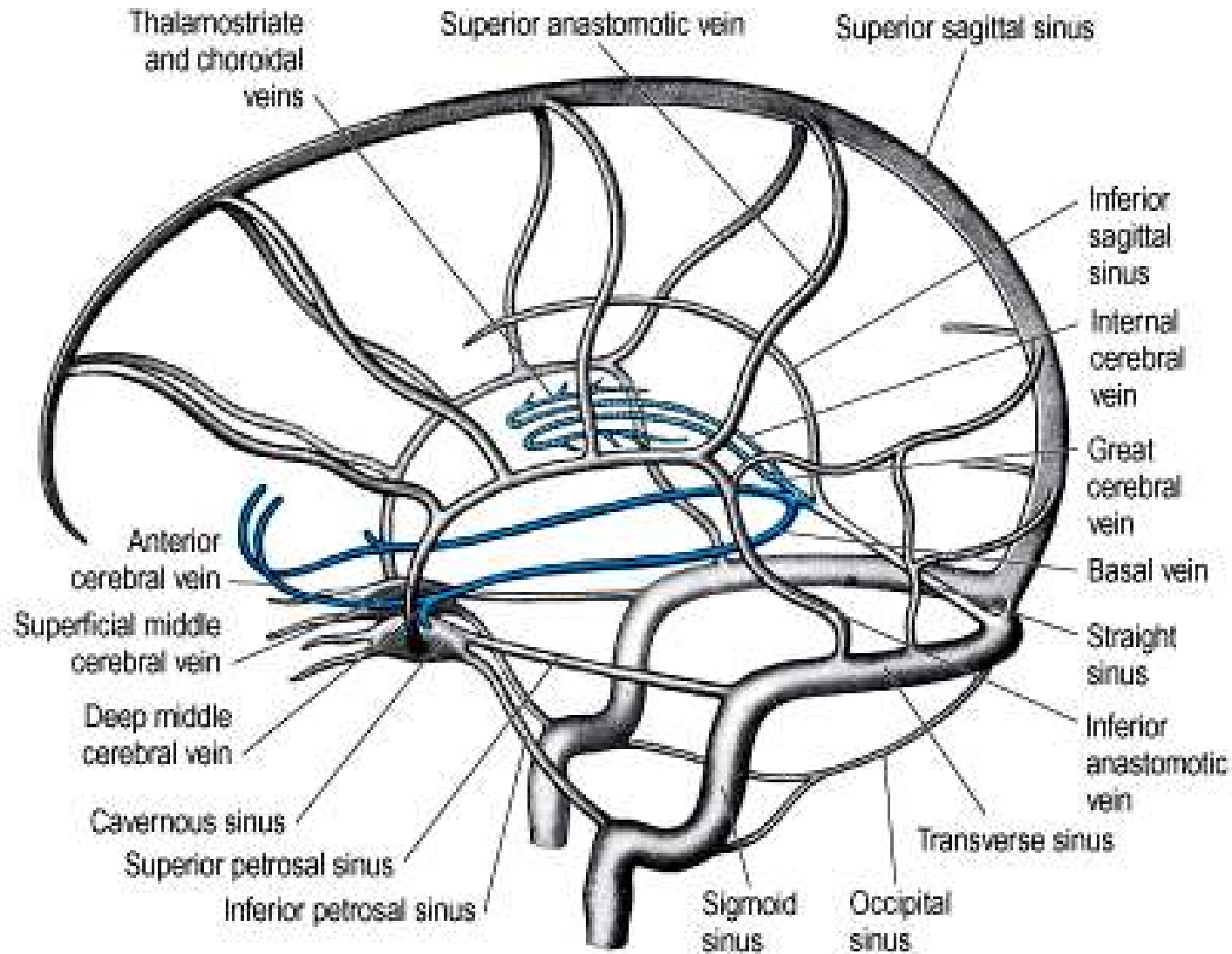
Internal Cerebral Veins

VEIN	AREA	DRAINS INTO
Thalamostriate	Basal ganglia, thalamus, internal capsule, Tela choroidae of 3 rd ventricle, hippocampus	- Both veins (of each side) unite to form Internal Cerebral vein ↓
Choroidal		- Rt. & Lt. Internal cerebral veins unite to form Great Cerebral vein ↓ -The Great cerebral vein join the Inferior Sagittal sinus to form Straight sinus ↓
		DURAL VENOUS SINUS

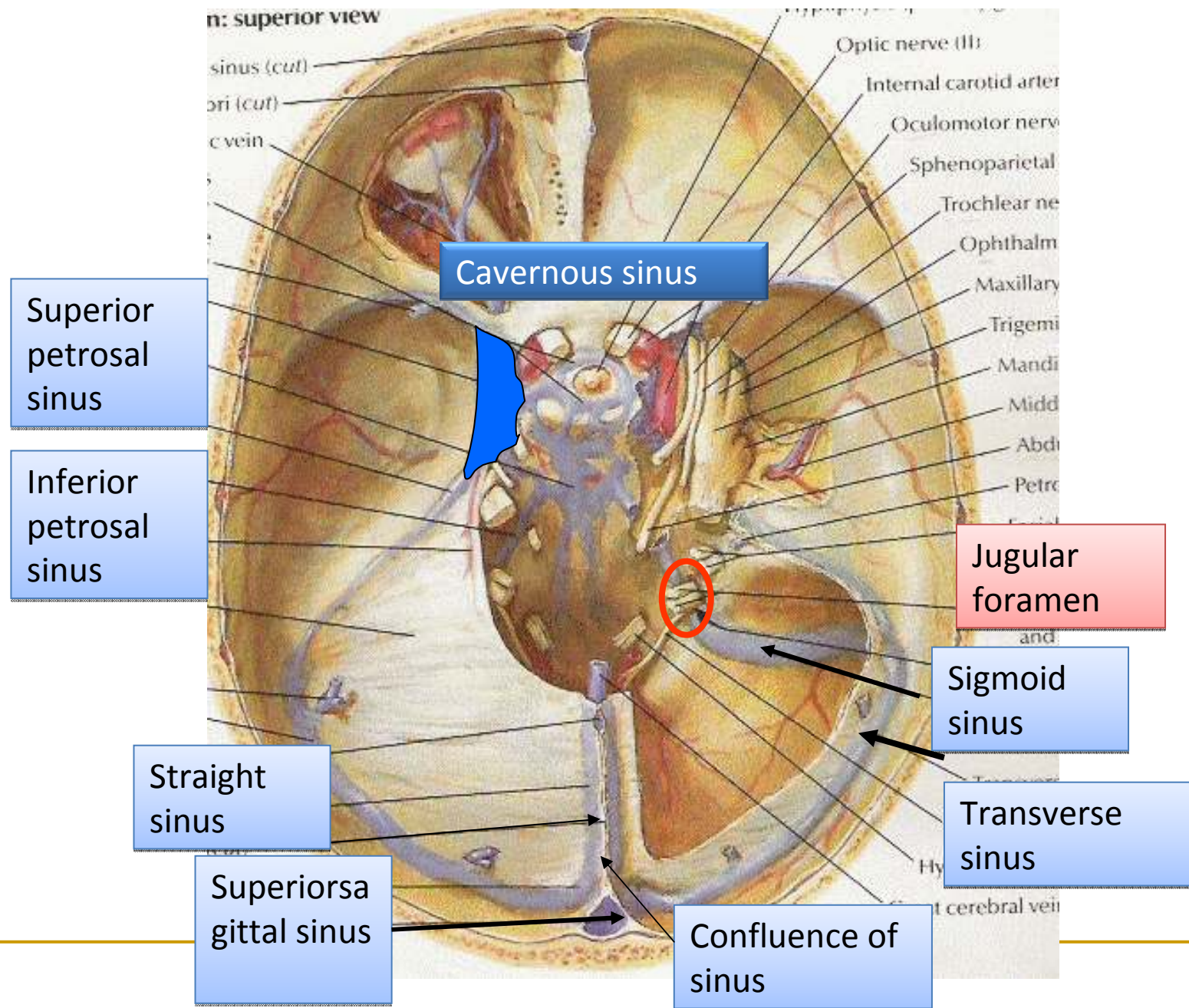
Internal Cerebral Veins



The internal (deep) cerebral veins, viewed from above after removal of the central portion of the corpus callosum.



The cerebral venous system (viewed from the left side) showing the principal superficial and deep veins of the brain and their relationship to the dural venous sinuses. The more deeply placed veins are shown in blue and those inside the brain are shown in interrupted blue.



Inferior sagittal sinus

Superior sagittal sinus

Falx cerebri

Tentorium cerebelli

Superior petrosal sinus

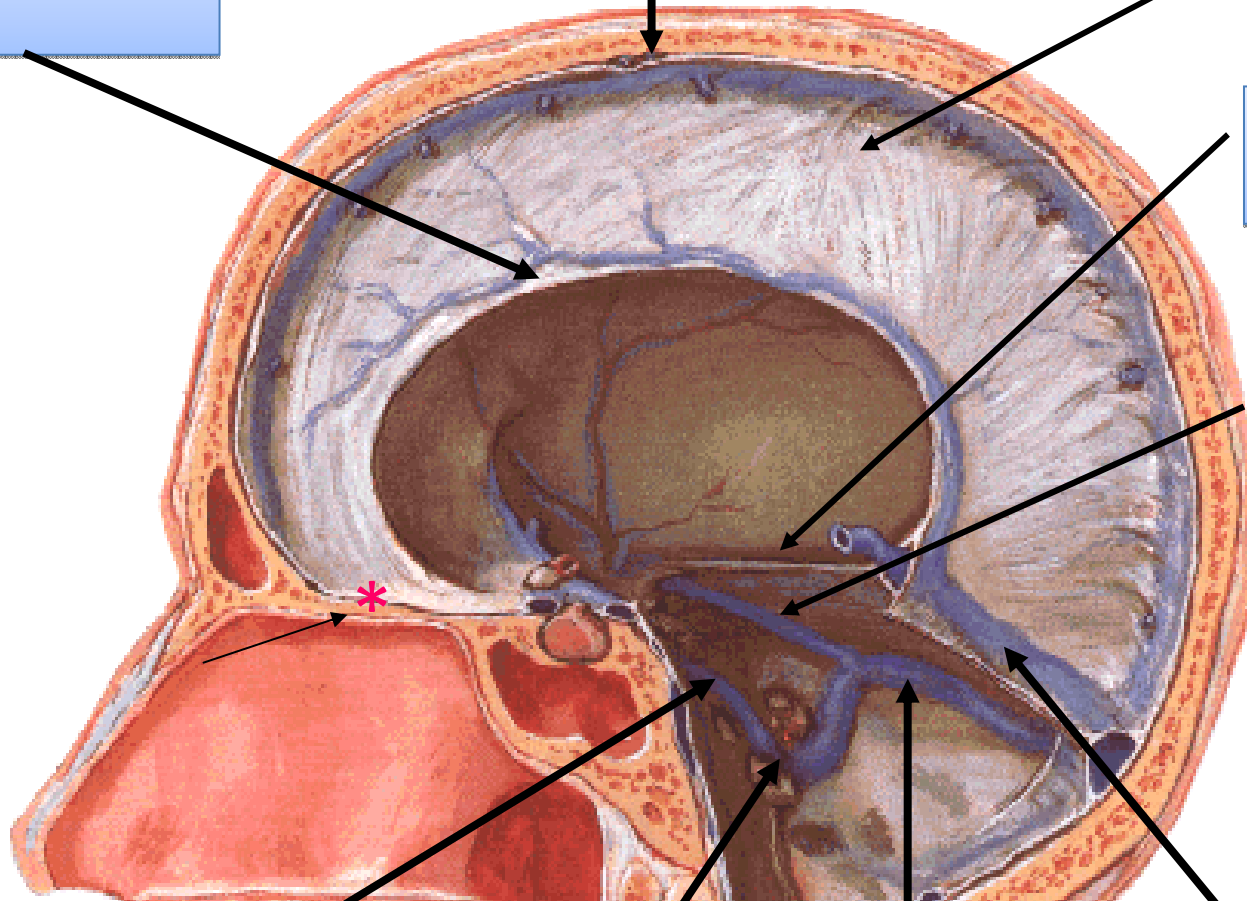
Confluence of sinus

Straight sinus

Inferior petrosal sinus

Sigmoid sinus

Transverse sinus



Veins of Specific Areas

Midbrain	Basal, great cerebral
Pons	Basal, cerebellar
Medulla oblongata	Anterior & posterior spinal
Cerebellum	Great cerebral

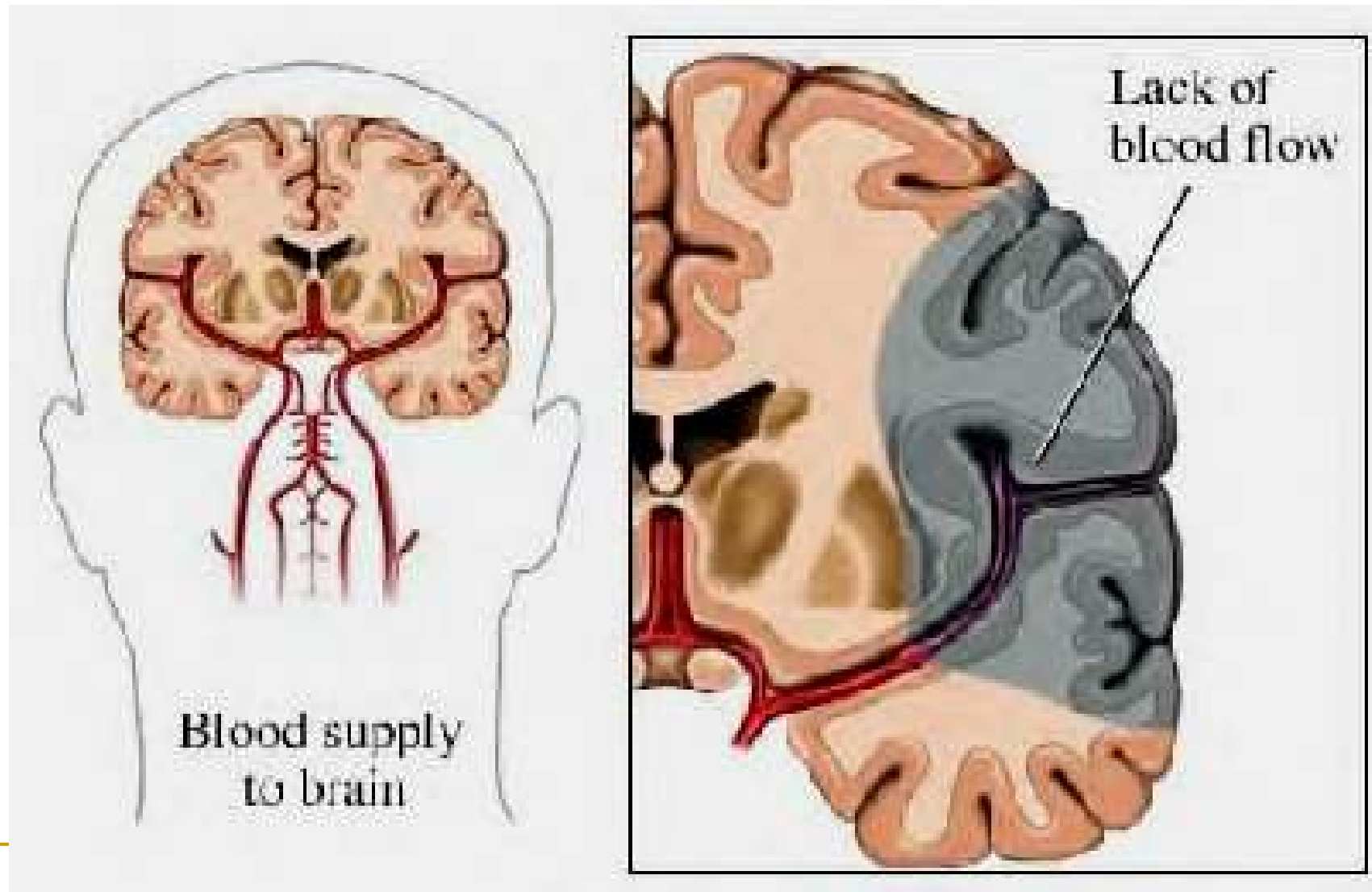
Cavernous sinus

- **Lateral to body of sphenoid bone**
 - **Connected to opposite – intercavernous S**
 - **Receives blood**
 - **Middle cerebral V**
 - **Drains into**
 - **Int Jugular V –via Inf petrosal sinus**
 - **Transverse S – via Sup petrosal S**
 - **Dural Venous sinuses – emissary veins – extracranial V**
-

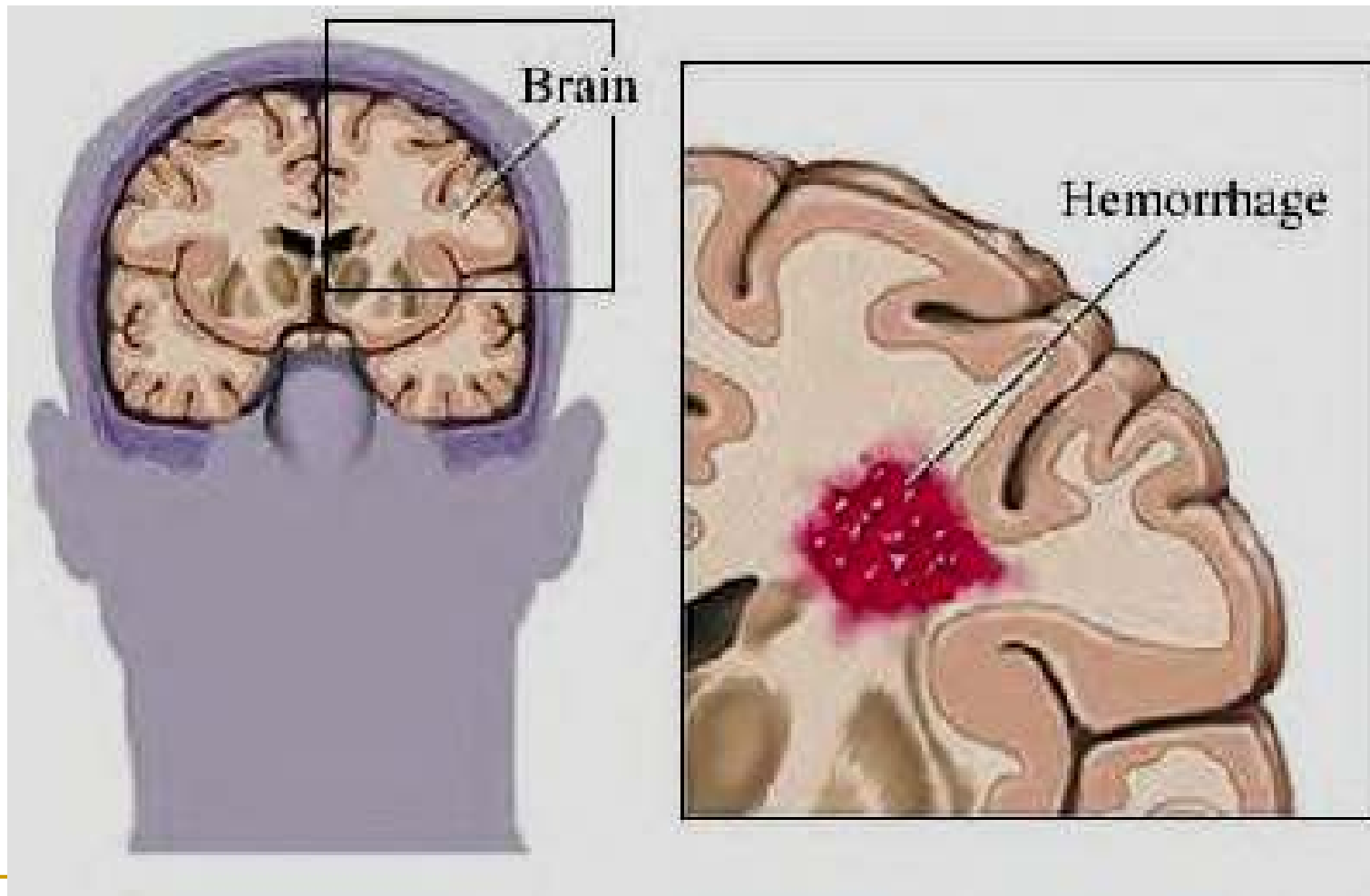
Clinical Application

- Stroke or cerebrovascular accident:-
 - ❑ Blockage in the artery – cerebral infarction
 - Carotid artery
 - Basilar artery
 - ❑ Bleeding within the brain – intracerebral haemorrhage
 - Aneurysm
 - Subarachnoid haemorrhage
 - Intracerebral haemorrhage - hypertension
 - ❑ Damages one side of the body - contralateral
-

CVA – due to blockage



CVA – due to haemorrhage





THANK YOU

